A NEW THEORY

OF

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PREFATORY.

Huxley tells us, in his Monograph on the Crayfish, that "Common - sense is science exactly in so far as it fulfils the ideal of common-sense; that is, sees facts as they are, or at anyrate without the distortion of prejudice, and reasons from them in accordance with the dictates of sound judgment. And science is simply common-sense at its best, that is rigidly accurate in observation and merciless to fallacy in logic."

We propose to test by the common-sense that Huxley says is science, whether the Darwinian doctrine, that the evolution of life on our planet was brought about by natural selection and other secondary causes,

accords with ascertained facts, or satisfactorily accounts for the natural phenomena it professes to explain, and, also, to submit a new theory that will explain satisfactorily the admitted facts of evolution.

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CONTENTS.

PART II.

PART I.

CHAPTER I.

ORGANIC EVOLUTION.

The geological record of our planet informs us that life first appeared on the earth in simple forms; that these simple forms were, in the course of ages, succeeded by numberless varieties of plants and animals, whose organisation, as new types successively appeared, became, as a general rule, more and more highly specialised, until at last Man appeared upon the scene.

Embryology seems to tell a similar story. The embryo of every mammal, including man, presents in its growth from the germ-cell to maturity, phases similar to those in the embryos of other organisms less highly specialised; in other words, the fœtus of each succeeding type resembles, in at least the earlier stages of its growth, that of its antecessor, and only as maturity approaches does it assume its own special characteristics.

These facts are summed up in ORGANIC EVOLUTION; and, according to Darwin, NATURAL SELECTION was the means by which evolution was brought about. Evolution is thus quite distinct from natural selection.

Evolution is an accepted fact, but it is denied that evolution was brought about by natural selection. The succession of different types, and the fundamental similarity in organisation between any race and its antecessor in the same line of evolution, are established facts confirmed by the continuous discoveries of science, and it is Darwin's glory that he made them familiar to the public mind; but evidence of evolution does not prove that evolution was brought about by natural selection; neither does it establish the truth of natural selection to show that the Mosaic cosmogony is not in accordance with the facts of geology.

Until the middle of last century the Mosaic account of the creation of animals and plants was generally accepted and stoutly upheld by dogmatic theology; but in 1859 Darwin made public his theory of the evolution of species from the first simple forms of life by natural causes, and this theory, after much controversy, became, and is still, widely ac-

cepted as the explanation of the phenomena in the evolution of life on our globe.

Darwin did not formulate his theory, but after setting forth at great length the facts and considerations on which his conclusions were based, declared himself to be thoroughly convinced that all animals and plants were descended from a few progenitors (whose existence he assumed), modified by secondary causes, through a long course of descent, and by "spontaneous variation."

To facilitate comparison of the two theories we propose, first, to submit our theory of evolution, and then to discuss the operation of Darwin's secondary causes, and his interpretations of the phenomena on which his theory is based.

CHAPTER II.

LIFE.

We know and can know nothing of life in the abstract—that is, apart from its manifestations; but that does not preclude us from endeavouring to discover its laws by the study of its phenomena, or the process of its evolution by tracing its progress in the races of plants and animals that successively appeared on the earth.

We know nothing in the abstract of the force called gravitation, but we conclude from its phenomena that there is a specific force that operates according to certain unvarying laws, and from these laws we can predicate how matter will be affected by gravitation under all known conditions.

Nothing is known of ether, and we have even no direct evidence of its existence, but scientific authorities assume that there must be a something which they name ether to

account for certain phenomena otherwise inexplicable.

Pursuing a similar line of inquiry, the phenomena of life presented during the growth of an organism from its germ-cell to maturity indicate that an organism is the product of three principal factors:—

The matter or food that goes to build up the organism;

The external conditions necessary for its growth; and

A combination of forces that actuates the general mechanism of the organism, selects and assimilates suitable food, and builds up a specific type.

Further, we may infer that the co-operating forces are of two kinds: a General force, common to all life; and a Specific force, peculiar to each race, that selects and assimilates suitable food, and builds up a specific type of that race.

It may be that the food assimilated reinforces the general life-force, but we cannot see how food or conditions of existence can provide the Specific life-force that forms the specific type.

We therefore infer that the Specific life-force of the organism comes from its germ-cell, and, as the germ-cell is the joint product of

the progenitors, that Specific life-force is transmitted by the progenitors and inherited by the progeny.

Now we know that the same physical force, acting under like conditions on the same kind of matter, is invariably attended by the same result, and if the same law extends to life-force, a Specific life-force, acting under like conditions in conjunction with the same kinds of matter, will invariably evolve an organism of the same type; and therefore, assuming that Specific life-force is transmitted from parent to offspring, heredity is a necessary outcome of reproduction: like will produce like.

On the same principle, any difference in the potency of the General or of the Specific life-forces transmitted, or in the respective potencies of the two progenitors, will be attended by corresponding differences in the organism they produce.

It is common observation that individuals of the same race differ in inherited vitality or life-force, and we know that rarely do two individuals grow to maturity under the same conditions in respect of quality or quantity of food or external influences, and it therefore necessarily follows that there will be differences in what we call "expression of

type" arising from differences in the qualities inherited and in the conditions of development of the organism.

All individuals of the same type will not be identical like castings of the same metal from the same mould, but must vary from each other with any variation in the respective influences of the several factors to which they owe their existence and development.

On the preceding facts and observations we base the following working hypothesis, which we propose to use as a key to further discoveries, and to test by the explanation it offers of various phenomena of life.

Hypothesis.

Life is a combination of forces that, in conjunction with specific kinds of matter, evolves, under favourable conditions, and according to constant definite laws, animals and plants.

Every organism is evolved by a General life-force in combination with a Specific life-force.

The General life-force is common to all life, but the Specific life-force is peculiar to each race, and builds up its specific type.

The Specific life-force determines the

type, but the expression of the type is the outcome partly of heredity and partly of the conditions of development.

The respective potencies, in modifying expression of type, of the General life-force, of the Specific life-force, and of the other factors of development, vary in different races and also among individuals of the same race or family.

Deductions.

From the preceding hypothesis come the following deductions :—

Expression of type is affected by the quality or energy of the General and Specific life-forces, and by the conditions of development.

The development of a type cannot exceed a full expression of the energy of its life-forces.

Without modification of a Specific life-force there can be no specific variation in type.[1]

[1] "Every variation of a living form, however minute, however apparently accidental, is inconceivable except as the expression of the operation of molecular forces or 'powers' resident within the organism. And as these forces certainly operate according to definite laws, their general result is, doubtless, in accordance with some general law which subsumes them all."—Huxley, Darwiniana, p. 182.

CHAPTER III.

DEVELOPMENT AND ITS RESULTS.

We now proceed to enquire whether the abstract conclusions of the last chapter are confirmed by the results of practical experience.

Evidence of this description, to be of value, must not be based on a few cases of doubtful authenticity, or on phenomena whose significance is imperfectly understood, but on results so clear, general, and uniform as to justify the conclusion that they are the expression of all-pervading natural laws.

The weight and quality of such evidence are fully recognised by Mr Herbert Spencer in his 'Principles of Biology,' where (No. X. p. 242) he says :—

"Excluding those inductions that have been so fully verified as to rank with exact science, there are no inductions so trustworthy as those which have undergone the mercantile test. When we have thousands

of men whose profit or loss depends on the truth of the inferences they draw from simple and repeated observations; and when we find that the inferences arrived at, and handed down from generation to generation of those deeply interested observers, have become an unshakable conviction, we may accept it without hesitation."

Now, evidence of this character is provided by the uniform experience of skilful breeders of all domestic animals; but we shall deal only with the breeding of cattle, because the various races are closely allied, their habits and appearance are generally known, their mating is closely controlled, their pedigrees are well authenticated, and numerous families or herds are bred under different conditions throughout the country. Cattle-breeding, in short, provides wider and more trustworthy results than can be had of any other domestic race.

Theoretically the object of selective breeding is to develop the fullest expression of the type of the race, and its practice consists in carefully selecting for breeding purposes animals that, in the breeder's judgment, possess the best expression of the type; and so again with their progeny.

The animals selected are carefully pro-

tected from any struggle for existence — that is, they are kept in comfort and fully supplied with suitable food, but otherwise under natural conditions. By such systematic breeding any cross-blood in the herd is practically eliminated in a few generations; and by selecting the most vigorous animals and developing their progeny under the most favourable conditions, a full expression of type is evolved.

So treated, the herd of the successful breeder will in a few generations approximate, perhaps as closely as it ever will, to a full expression of the type. There were as good specimens of our pedigreed breeds of cattle fifty years ago as there are to-day.

Selective breeding has been steadily prosecuted for three-quarters of a century, and has brought about a higher average expression of type among cattle generally than formerly obtained, but there has been no tendency to *specific* variation in type. On the contrary, the invariable experience has been that the longer selective breeding is pursued, the more firmly established becomes the family expression of a herd, and the more forcibly do the parents stamp the family likeness on their progeny.

But with improved expression of type the

breeder finds himself in the presence of unexpected obstacles to further development, and they prove insurmountable. If the young stock go unmated to the age when cattle not highly bred reach puberty, the animals, whether male or female, will probably prove infertile, and that without any obvious cause.

The breeder also finds that development has so stimulated precocity that cases have been known where a female only eleven months old has produced a calf; and such cases at thirteen months are not uncommon.

The dam of eleven months had conceived when a calf only two months old, instead of at fifteen to eighteen months—the usual age of puberty among animals not highly bred.

In these circumstances the breeder seeks to avoid sterility in the mature animals by breeding from his young stock when barely half grown. But as the immature dam cannot be fully protected in the struggle between her own growth and that of her unborn calf, both suffer, and both fail to equal their progenitors in development. Practically, a full expression of the type has been reached, and, to maintain the existence of the herd, its standard of excellence must be lowered by immature mating.

Development by selection and protection from the struggle for existence is thus limited by sterility or precocity.

The results of experience, therefore, confirm our abstract deductions—

That the development of a type cannot exceed a full expression of the energy of its life-forces; and

That without modification of a Specific life-force there can be no specific variation.

CHAPTER IV.

CROSS-BREEDING AND ITS RESULTS.

Any two breeds of cattle are fertile together, and, as a general rule, first crosses—hybrids—combine the best characteristics of both breeds, and for the grazier's purpose are usually superior to either parent.

But the progeny of hybrids with hybrids, which we call mongrels, are almost invariably inferior in form, weak in constitution, and frequently infertile.

Without an admixture of pure blood mongrels certainly fail, for one reason or another, to perpetuate their type beyond two or three generations, even although parents and progeny are carefully protected from any struggle for their existence.

Darwin was fully aware of the infertility of hybrids, both of animals and plants, but does not seem to have fully realised its significance in evolution.

"The embryo of hybrids," he says, "frequently dies prematurely, and if born, seems to be defective in vitality."[1]

He also refers to experiments with eggs of cross-bred fowls, where nearly all the few chickens that emerged from the shell died soon after "without any cause, apparently from mere inability to live."[1]

The sterility of some hybrids was not to be anticipated, for if the life-forces of two races are so closely allied that they can combine to produce a hybrid, might it not be expected that the life-forces of the hybrids, inferentially still more closely allied, would prove more fertile?

But uniform experience emphatically negatives the inference, even in the case of races so closely allied as our breeds of domestic cattle.

In this elimination of mongrel stock may we not recognise Nature's hostility to a new type?

Attempts have been made, with more or less success, to vary expression of type by intermixture, to a limited extent, of the blood of another breed.

If a hybrid is bred into the race of either parent, and the progeny again into

[1] Origin of Species, Ed. vi., p. 249.

the race selected, fertility may be maintained, and individuals apparently pure will ultimately be produced; but even after several generations a calf will occasionally appear with distinct characteristics of the discarded breed.

Such cases of atavism seem to indicate a reluctance in Nature to lose a type, and also a tendency in the event of an accidental deviation — a monstrosity, for example—to revert to the original form.

Crossing between two races occurs but rarely in a state of nature. The brown and the mountain hare, although similar, do not mate, even when they live together on the same mountain-side; neither do grouse and ptarmigan; and it may be doubtful whether cattle of different breeds would mate together if free to choose.

We certainly know that a strong feeling of aversion exists between many races of mankind[1]—probably more or less among all.

It is remarkable that of white races this aversion is strongest in Gipsies and Jews, who, living amongst other nations, might be expected to have the strongest temptations to intermarry with another race.

[1] Witness the lynchings in the United States.

If the purpose of this feeling of aversion is not to maintain purity of race, it certainly exercises a powerful, if unconscious, influence in that direction.

CHAPTER V.

PURITY OF RACE.

We have hitherto dealt with the Specific life-force of each race as an unity, but it is actually dual—male and female—at least in the higher organisms.

It cannot with confidence be affirmed that either sex has a preponderating influence in reproduction, or, excepting the sexual organisation, in forming any particular organs or in determining character or disposition in the progeny; for sometimes the progeny take after the male, sometimes after the female, and again, likeness to an ancestor more or less remote may predominate.

Further, the progeny may in physique resemble the one parent, and in character and disposition the other. Physique and character are thus not indissolubly combined in Specific life-force.

These variations in the respective influ-

ences of the parents on their progeny are readily observable in the hybrids of two highly contrasted "varieties," and especially where there are several young at a birth. In a litter of hybrid dogs, some may at maturity resemble the male and others the female, while some may be intermediate. These variations, in the respective potencies of the sexes in reproduction, can hardly be more clearly demonstrated than by the photographs of white and black oat plants and their hybrids, grown for the purpose of determining whether oats are naturally cross-fertilised (see plates, pp. 24, 25), by Mr Thomas Jamieson, F.I.C., Director of the Aberdeenshire Agricultural Research Association.

These very interesting and instructive examples of variations in the respective reproductive potency of the sexes suggest a wide field for speculation on the processes of reproduction; but it is sufficient for our present purpose that they, as well as hybrid puppies, justify the inference that individual characteristics of two parents are not equally divided—not always at least—in their offspring, and also the assumption that where likeness to one parent preponderates, that individual has in similar

proportion more of the blood of the parent it resembles than of the other, from which it differs in expression of type.

This feature of heredity discloses one of Nature's methods — perhaps the most important after race hatred — for maintaining purity of race, and it is the guide to success in selective breeding.

As we have seen, the stock of hybrids, without intermixture of pure or nearly pure blood, disappears; but if the hybrid and its progeny are bred into the pure stock of either parent, the descendants have in two or three generations all the appearance of that race.

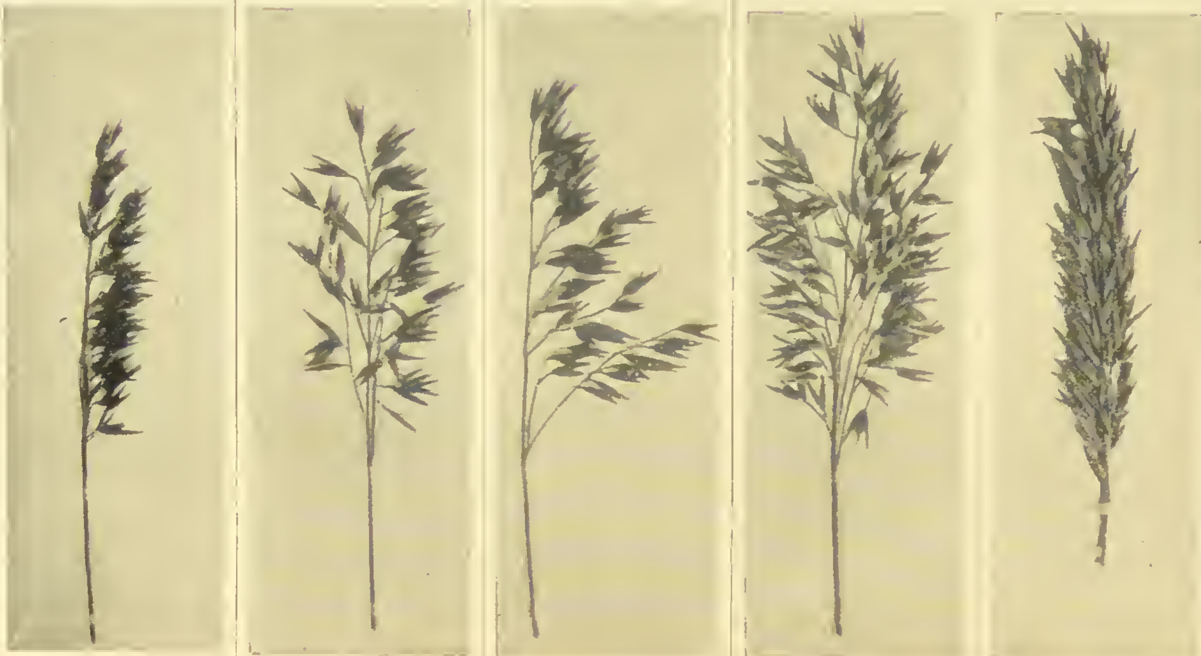
This result will evidently be accelerated if such of the progeny as take after the race of one parent are bred into that race. And that is the practice in selective breeding.

If a calf shows any strain of alien blood or inferiority in expression of type, it is destined to the butcher; and only if a bull-calf promises to become a higher expression of the type of its race than either parent, is it selected for improvement of the herd.

Selective breeding thus co-operates with Nature, and thereby attains more promptly

(*For details see 'Report of the Agricultural*

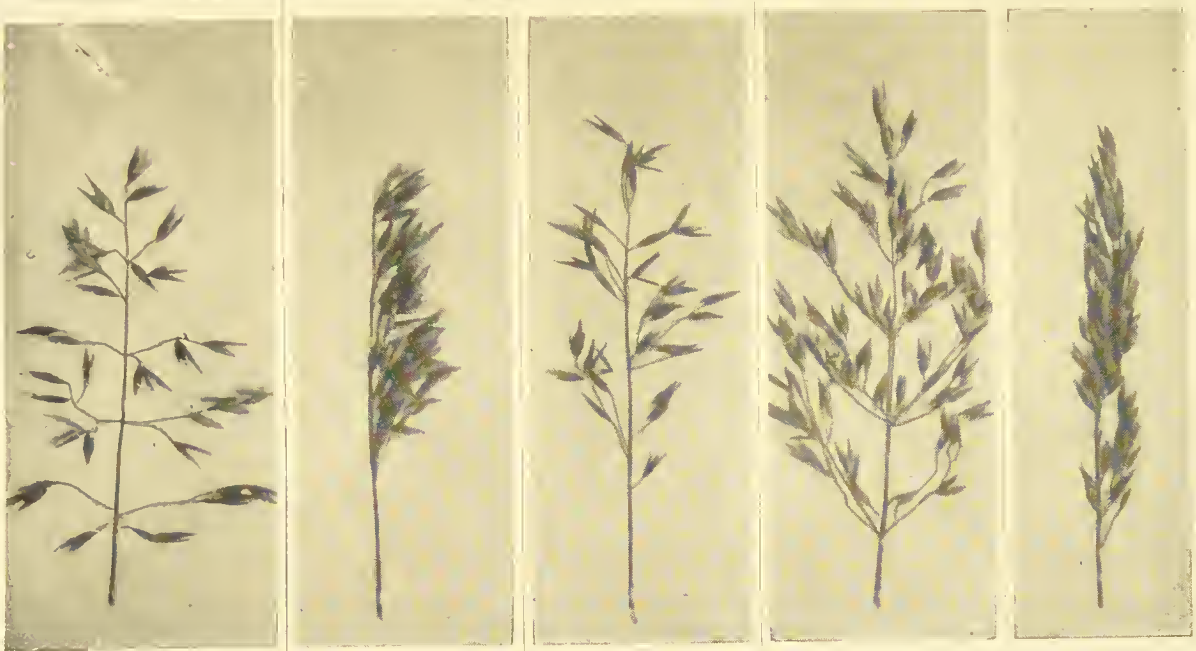
Plants of Black Oats.	Plants from seed grown on stems of Black Oats, crossed by White Oats grown alongside.			
Branches on one side, erect. Black seeds.	Branches on two sides, half-erect. Black seeds.	Branches on one side, pendulous. Black seeds.	Branches on all sides, half-erect. Brownish seeds.	Branches on all sides, erect. Brownish seeds.



OSS-FERTILISATION OF OATS.

search Association for 1897,' pp. 41-61.)

Plant of White Oats.	Plants from seed grown on stems of White Oats, crossed by Black Oats grown alongside.			
Branches on all sides, horizontal. White seeds.	Branches on one side, erect. White seeds.	Branches on two sides, half-erect. White seeds.	Branches on all sides, half-erect. Creamy seeds.	Branches on all sides, erect. Creamy seeds.



The female influence seems to preponderate in determining the colours.

than Nature unaided, their common object —purity of race.

It was no doubt by acting, it may be unconsciously, on this—Nature's method of selection—that the pedigreed herds of this country were established.

CHAPTER VI.

THE HUMAN RACE.

In view of the homology throughout Nature, it may be assumed that the experience in breeding cattle would, under corresponding conditions, be repeated in the human race, and in that case it would follow—

That the species *Homo sapiens* is not descended from a single pair of ancestors, but is composed of many distinct races; and

That intermarriage between two races will not, without the intermixture of pure blood, produce a permanent stock.

We may thus understand why there are no mongrel descendants beyond the first or second generation of Eurasians in India, or of mulattoes in the United States. If mulattoes married whites, they might ultimately become absorbed in the white population, but this is doubtful.

It has been stated that octoroons die at an

early age, and it may be that where the difference between two races is so great as between the white and the negro, the lower race will not be elevated to the higher, and that the crossed descendants die out.

We have heard of cases where a limited number of Europeans have settled among a civilised dusky population and married native women, but instead of the Europeans being absorbed in the native population, the progeny have retained the European type, although they have deteriorated in mental qualities.

If there are such cases, it might be surmised that the European life-force was so prepotent that, although in smaller proportion than the native, it maintained its ascendancy in the hybrid, while on the other hand the mental characteristics of the native prevailed.

A close study of such cases, if such there are, would doubtless throw much light on the phenomena of cross-breeding, but in the absence of full information we are reduced to mere speculation ; and it ought to be kept in view that at least a hundred years must elapse before the materials for a definite conclusion could be provided.

It may be objected to our conclusions that the people of Great Britain are largely com-

posed of mixed races, and that neither their fertility nor vitality is impaired. But as we have seen in the cross-breeding of cattle, Nature has her own effectual automatic methods of maintaining purity of race.

The history of the offspring of mixed marriages would, we believe, show that unless they married into a pure race the stock soon became extinct. We know of no statistics on this deeply interesting question, but examples will probably occur to the reader.

The inscrutable feeling of aversion between human races (race-hatred) must tend, perhaps unconsciously, to prevent mixed marriages, and so to maintain purity of race. May not this purpose account for the existence of this mysterious feeling not only in the human race, but also among lower animals?

A race that lives in an alien country, like the Jews or Gipsies, and intermarries only with its own people, remains pure; but usually a minority becomes absorbed in the majority, or otherwise disappears, although examples of atavism will occur even after several generations.

Notable examples of the Saxon type may still be seen in Tipperary, where a colony of Cromwell's Ironsides settled nearly three centuries ago.

Character.

We are at present dealing with the physical aspect of evolution, but our reasoning applies with equal force to mental qualities and disposition (character).

Every race of man has its own individuality, but the characters of most civilised nations merge into each other so gradually, that only outstanding characteristics can be clearly defined or recognised.

There is, however, no difficulty in recognising the distinctive characters of the Celt, the Gipsy, and the Jew, and the persistence of their characters through extended periods of history, and varying conditions of existence, strongly supports the contention that mental and physical characteristics are equally immutable, although among individuals of the same race, character, like physique, varies in expression.

CHAPTER VII.

GENERAL CONCLUSIONS, AND IMPORTANCE OF A TRUE THEORY OF EVOLUTION.

On our hypothesis and interpretation of the facts and experience set forth in the preceding pages are based the following conclusions:—

Distinct races are far more numerous than species, so called.

Only the stock of a pure race is permanent.

Continuous fertility and persistence of stock is the true test of a distinct race.

The first ancestors of every race were of the same specific type as their existing descendants.

Type, although variable in expression, is immutable.

A modification of type by crossing two races—that is, an intermediate type—is not persistent.

Hybrids may in certain cases be bred into the type of either parent, but characteristics of the discarded race occasionally appear, even in remote descendants.

Every race has an instinctive aversion to mate with any other race.

The development of a race in physique, character, or mental qualities cannot go beyond a full expression of the capacity of its life-force.

Every race differs specifically from any other race, not only in physical type but also in character; and individuals of the same race differ from each other in expression of the same type.

Development in physical type, or in character, is limited to a full expression of the life-force with which each race or individual was originally endowed.

The physique and intellectual qualities of a parent may be dissociated from each other in the offspring.

Importance of a true Theory of Evolution.

Theories of evolution may at first sight seem of small practical importance in the affairs of life, but on reflection we cannot fail to recognise the great value of a true solution of the problem of evolution to all concerned in the government or management of mankind, as well as to breeders of animals.

If the preceding conclusions are well founded we can see the causes of phenomena otherwise inexplicable.

We can understand, for example—

Why Copts and Arabs, who have lived together on the banks of the Nile for more than a thousand years, have not amalgamated.[1]

Why in Asia Minor Turks and fragments of several races, although they live in the same or adjacent villages, remain apart, each retaining its own distinctive characteristics and habits mental and physical.[2]

Why the Chinese and other ancient civilisations, after having developed a full expression of their Specific life-force, failed to make further progress.

[1] See Mrs Duff Gordon's 'Letters from Egypt.'

[2] See 'Impressions of Turkey,' by Prof. Ramsay, D.C.L., LL.D.

Why eminent men in all ages, after exhibiting great proficiency or skill, either declined or failed to advance. If some men of transcendent genius seem exceptions, they are so few that the exceptions tend to prove the rule.

Why Negroes, Kaffirs, or other inferior races cannot raise themselves, or be raised, to the level of the white races.

Why a negroid hybrid of dark colour may possess the intellectual faculties of a white race; or,

The futility of attempting to educate a brain above the capacity with which it has been endowed.

CHAPTER VIII.

ANALOGIES.

Analogies are not proofs, but they facilitate the explanation of abstract ideas and theoretical processes, and with this object we gladly avail ourselves of the developments of the loom and of the steam-engine to illustrate our theory of the evolution of life.

The Art of Weaving.

The Jacquard loom may be described as a mechanism that, when set in motion and supplied with suitable material, will go on weaving cloth of identically the same texture and pattern, so long as the speed of the machine, the material, and the conditions remain unchanged.

The forces of the loom are of two kinds: one a "general" force—the motive power; and the other—a force specific to every web of different pattern—produces the particular

pattern of the web, as the General and Specific life-forces in the germ-cell combine to develop an organism of a specific type.

The speed of the loom, the quality of the yarn, and the conditions of manufacture may vary, and any variation will so affect the web that the skilled eye can detect a corresponding difference in the cloth, just as the breeder can recognise different expressions of the same type among the animals he breeds, arising from analogous causes.

The art of weaving was developed from the simple to the complex by successive steps or stages; so also the evolution of life.

The method of weaving varies, but the underlying principle — the interlacing of filaments—is the same throughout; as in life, all growth is by the multiplication of cells.

Plants and animals may be classified to illustrate the successive steps in evolution. In like manner products of the loom may be arranged to show clearly the successive stages in the development of weaving, and the several fabrics will have so much in common that the complex might seem to have grown out of the simple,—as in a sense it did. But no intelligent observer would

conclude that the brocade of the Duchess was evolved from the mat of the savage by selection, or by environment, or by "spontaneous" variation.

We know that for every new fabric and every new pattern of the web, the ingenuity of man had to devise a new combination of force, or to prepare a different design.

Again, as the fœtus of the mammal exhibits in its growth successive phases in the evolution of life, so successive steps in the evolution of the loom may be recognised in the weaving of complicated fabrics. For example, in manufacturing a damask tablecloth, having a plain border surrounding a twilled square with a pattern of flowers in the centre, the loom weaves first the border on the simple plan of crossed threads—the method of the primitive loom; a development is indicated in the weaving of the outer portion of the square—the threads are crossed in a new fashion to throw up a simple pattern—and then a further stage is exhibited in the centrepiece of flowers. To change the centre pattern from flowers to, say, shells, the same combinations that wove the first and second stages of the tablecloth with flowers, weave also the same stages of that with the shell centre.

A new combination is necessary only to differentiate the centre patterns; the forces that wove the first cloth are used for the second, so far as they will subserve the new design.

And so in the evolution of life, the Specific life-force of the antecessor was utilised in evolving its successor, so far as it would subserve that purpose.

The Steam-engine.

The steam-engines of the present day, Parson's turbine excepted, have been evolved from the Cornish pumping-engine of a century past. The evolution has been by numberless steps—some insignificant, others might be called gigantic; but, small or large, each was the result of an application of man's intelligence and skill to the improvement of an existing machine; and each successive step may be discovered by a comparative study of the engines successively constructed.

Steam-engines vary greatly in character and appearance, but as the naturalist classifies animals, so an expert engineer could classify steam-engines into families, genera, species, and varieties; each as clearly defined to the professional eye as

animals, by their classification, to the naturalist. The expert could also explain each successive step in development, and point out the changes in the structure, just as the morphologist can specify the higher, or in some cases the lower specialisation of the different organisms that succeeded each other.

Taking a wide, tall, spreading tree as an illustration, the expert might show how the piston and cylinder, like the stem of the tree, have developed in size and character; how the cylinder got its power first from atmospheric pressure only, then from air and steam combined, and later from steam only; while at the same time the stem threw off branches on all sides—represented by the condenser, the superheater, the fly-wheel, governor, and other improvements, that again on their part developed in character and efficiency.

The expert might then invite attention to the manner in which the changes were effected: how the first engines were simplest in construction; how the design of an existing type of engine was utilised, so far as it would serve, for the new; how some organ of the old engine was transformed into something different in the new; and how occasionally a fragment of some member

essential to the earlier machine might, although useless, be found in the new, provided it did not interfere with efficiency.

Then he may also point out that the development was not invariably towards higher specialisation, for, as in the case of the steam-hammer, the new machine was sometimes less highly specialised than its antecessor.

All these features in the development of the steam-engine have parallels in the evolution of life.

Like the first steam-engine, the earliest forms of life were the simplest. Embryology tells us that, so far as the organisations were alike, every new type of life was based on its antecessor, and that some organs of an antecessor became transformed in its successor; while occasionally the fragments of an organ, essential in the old type, are to be found, although apparently useless, in the new.

Again, the expert might dwell on the wide gap in some cases between an old type of engine and a new, in whose structure intermediate developments had been entirely superseded by new inventions.

Similarly, and possibly for similar reasons, wide gaps in the evolution of life some-

times occur between a new type and its immediate (known) antecessor.

Comparing engines of the same variety, the expert might observe that no two engines are absolutely identical, but differ in respect of quality of materials or of workmanship, or in efficiency, just as from analogous causes two animals of the same race differ in expression of type or in energy.

Reviewing the development as a whole, the expert might explain how some of the earlier types of engine have, like certain types of organisms, survived, while others, intermediate between them and the engine of to-day, have disappeared.

The development of the steam-engine progressed in accordance with man's necessities. Many of our present engines would have been useless until the necessity for them arose or conditions necessary for their use were provided, and if the scheme of evolution were fully disclosed, we should probably understand the reason for the successive developments of life—why some types persist through ages unchanged, and why others disappeared, or became more or less highly specialised.

Are all these parallels between the evolu-

tion of life and of the works of man mere coincidences?

Do they not indicate that the intelligence and power manifested in the development of the steam-engine are, though infinitely lower in degree, akin to those that evolved successive forms of life, and do they not justify the presumption, that there is a certain analogy between man's method of developing his works and the evolution of life?

If, then, we are to inquire into Nature's methods, should we not advance most surely by comparison, based on our observation and experience, of the processes of Nature and of man?

The homology throughout Nature suggests that the laws of the forces which we call life are analogous to those of the forces that pervade inanimate Nature, and are we not bound to assume that in the evolution of life there was no effect without a corresponding Cause, nothing spontaneous or accidental?

CHAPTER IX.

THEORY OF EVOLUTION.

We now proceed to formulate our Theory of Evolution, recognising fully that it shall be subject to Huxley's test, that "Every hypothesis is bound to explain, or at any-rate not be inconsistent with, the whole of the facts which it professes to account for, and if there is a single one of these facts which can be shown to be inconsistent with (I do not merely mean inexplicable by, but contrary to) the hypothesis, the hypothesis falls to the ground—it is worth nothing." [1]

The evolution of life was by successive steps—each step a distinct new type.

The first forms of life (which all theories assume) consisted of a simple cell, that by inherent force (which we call "life-force") multiplied by producing other similar cells.

[1] Darwiniana, p. 463.

Thereafter more complex life-forces, owing existence to the same constructive Power as the first, successively evolved new organisms, widely diversified in form, and, as a rule, more and more highly specialised, until the evolution culminated in Man.

In the process of evolution the Specific life-force of an existing organism was utilised in evolving a new type, so far as the old and the new were alike: in other words, the new structure was built on old foundations.

Evolution was not invariably towards higher specialisation, nor was it restricted to one line of development. Like a lofty, wide-spreading tree, the main stem of evolution put forth branches in all directions, some more or less divergent from the upright trunk, others horizontal, and not a few downwards; but the evolution throughout was on the same principles—development by utilising, as far as serviceable, the Specific life-force of an existing type to evolve a new, and, growth by accretion of cells.

The differentiation between successive types was effected by modifying, or adding to, an existing Specific life-force.

Thus not only every species, but every

race, arose by a special intervention that modified a Specific life-force already in existence.

Speculative.

Conception is the incarnation of life, and we may surmise that the modification of an existing Specific life-force to produce a new type was effected at conception by the same Power that first incarnated life.

It may be that, in the higher organisms, the fecundated ovum of an existing type was in some unknown manner again fecundated with a new force, and the old and new forces thus incorporated evolved the new type. Further, if the womb of the antecessor was utilised to foster the embryo, a new race was evolved by a single direct intervention of the same Power that called the first simple forms of life into existence. Was not the mammal evolved from the fish through the amphibia?

The first evidence of a new life is the growth of the germ-plasm. We cannot penetrate deeper in our search for the origin of life, but yet the question will suggest itself, Whence comes the inexhaustible supply of force to animate the count-

less millions of beings that every hour come into existence?

Judging by our experience of force in inanimate nature, a definite quantity of Specific life-force cannot, within itself, multiply or increase, and if Specific life-force comes from the progenitors, the first parents must have been endowed, not only with a sufficiency of vitality for themselves, but also for all their descendants.

But this would be at variance with Nature's parsimony in the use of means.

Again, if the Specific life-force of the individual is only sufficient for its own existence, whence comes the Specific life-force of its successor?

We know nothing of the forces that cause conception, or bring the embryo from the germ-cell, or develop the mature animal from the fœtus.

The ignorance of the untutored savage in a great factory, where machines, driven by invisible electric energy, automatically produce cunning designs, is not more profound than that of the most highly gifted of our race in Nature's workshop.

But may not the great factory with its invisible motive force suggest, that the world of life is continuously sustained and

renewed by invisible but all-pervading energy, from a source that is inexhaustible, and that every individual life, to all seeming independent, is in reality but a motor, actuated invisibly to discharge its appointed functions, until the connection with the vitalising energy is sundered?

It may not be unnecessary to observe, that our theory deals only with the life which is common to all animals.

CHAPTER X.

PHASES OF THE EMBRYO AND FRAGMENTARY ORGANS.

LET us now test our theory by its explanation of, perhaps, the most mysterious and at the same time most significant phenomena in evolution — the similarity of an embryo to that of an antecessor more or less remote, and the presence in many races of what we call fragmentary (not rudimentary) organs.

The embryo of every mammal presents in its growth phases similar to what may be seen in that of its antecessor, and there may, in some cases, be observed the transformation of certain partially formed organs of the antecessor into others, different in appearance, but performing similar functions, in the successor.

Again, in the bodies of many mammals are found fragments of organs once perfect in the antecessor, but now apparently superfluous to their present owner.

These footprints of evolution seem to present a clue to the method of its progress; and to explain these phenomena satisfactorily, is an important test of any theory of evolution.

According to our theory, the phases in the growth of an embryo should resemble the corresponding phases in the embryo of its antecessor, up to the stage when the Specific life-force of the successor begins to differentiate the new type. When the differentiation between the old type and the new is slight, as in the case of what are called varieties of the same species, the modification of the pre-existing Specific life-force is slight, and the embryos are consequently similar up to an advanced stage in their growth.

In cases where the differentiation between two types arises only after birth, the mature fœtus of the one is not distinguishable from that of the other. But when the differentiation is important and extends to several organs, the co-operation of the old and the new Specific life-forces becomes more complicated. The sequence of the growth in the embryo of the organs of the old type and of the new is not always the same, and in such cases two forces seem for a time to be in

action, and to act independently of each other—the old force in fashioning an organ on the old plan, and the new force in forming some other organ according to the new type.

Thus at a certain stage the fœtus represents in part the old type and in part the new.

When, in such cases, the new Specific life-force seems to wholly supersede that of the antecessor, a partly fashioned, incongruous organ is dealt with, either—

By being re-formed into an organ of the new type; or,

By being wholly or partially absorbed; or,

By its growth being simply arrested.

The transformation of gills, visible at an early stage in the embryo of mammals, into lungs, is an example of the first process;

The incipient teeth, discernible at one time in the embryo of the Greenland whale, and afterwards wholly absorbed and replaced by whalebone, illustrates the second method; and

The third is represented by the rudimentary upper incisor teeth in the fœtus of the calf, arrested in growth and covered with a hard pad; or, again, by the frag-

ments of hind-limbs found inside the body of the Greenland whale.

According to this explanation fragmentary organs are parts of organs once perfect in an antecessor, and not the rudiments of organs that become perfect in a successor.

This explanation of the origin of fragmentary organs also explains why stages of evolution that, according to Darwinism, should be continuous in the embryo, do not appear in the embryonic development of some animals; for example, why the embryo of some snakes shows the gill-clefts of a fish, but no trace of the fore-limbs of an antecessor less remote.

Sometimes the differentiation, towards a higher or a lower specialisation, between an antecessor and an immediate successor, is so great that some organs of the immediate antecessor are altogether wanting in the successor. In such cases the differentiation in the new Specific life-force takes effect before the absent organs would begin to be formed in the embryo of the successor, and therefore the phases of the successor's embryo show no trace of them.

CHAPTER XI.

ENIGMAS AND THEIR SOLUTION.

Let us now analyse the processes in the marvellous transformations of the embryo during its growth, and endeavour to discover their significance and bearing on the general question of evolution.

We see that the embryo of a mammal develops, during at least the earlier phases of its growth, in the type of its antecessor, and that at a certain stage, which varies in different genera but is uniform in every race, what seems a new force intervenes and begins to evolve some organ in the type of the successor, which is not that of the antecessor, while some other organ is being formed in the type of the antecessor, which is not that of the successor. Thus there seem to be two forces of growth developing the embryo in different types, and in consequence the embryo in this stage is neither wholly in the type of the antecessor nor of the successor.

But presently the specific life-force of the successor seems to prevail, that of the antecessor is wholly superseded, and the fœtus is completed in the new type. The Greenland whale, for example, has no teeth, and yet its embryo at an early stage develops incipient teeth that afterwards disappear, and are replaced by whalebone. (See page 49.)

These facts seem to disclose two anomalies —two forces at work in the development of an embryo, and at one stage apparently in conflict; and again, the toothless whale begets an embryo that, contrary to the law of heredity as generally understood, develops incipient teeth, and is in this respect unlike its progenitors.

How are these seeming anomalies to be explained?

The apparent anomaly in the embryo of the whale arises from imperfect apprehension of the operation of heredity.

There are three distinct phases in the existence of a mammal—the germ-cell, the fœtus, and the animal. Now, the law of heredity prescribes that a mature mammal shall reproduce its race, not by begetting a miniature of itself, but a germ-plasm the same as that from which itself was evolved; further, that this germ-plasm shall develop

into a fœtus, and the fœtus into a mature animal, each in the respective types of the progenitor in the corresponding phases of its existence. The progenitor thus begets a germ-plasm like that from which it came, the germ-plasm evolves a fœtus, and the fœtus an animal of the same type, that will in its turn beget a germ-plasm like that from which it came; and from this germ-plasm will, in the appointed course, be evolved a successor in the likeness of its progenitor. And so the continuity of race through successive generations is maintained.

Looking backwards, it follows by continuity of descent—

That the germ-plasm and embryo of an existing mammal must be the same as those of its first ancestor;

That the embryo of the first ancestor presented in its growth the same phases that appear in the embryo of its latest descendant; and

That neither the germ-plasm nor the embryo is affected by any changes in the conditions of life to which its progenitors may have been subjected, or by any differences in their expression of type.

We therefore, in the growth of the embryo

of an existing mammal, witness the processes of the specific variation that formed its first ancestor into a new race.

The phases of the embryo thus fulfil the law of heredity, and present no anomaly.

These abstract conclusions are fully confirmed by the fact that the embryo of the whale, notwithstanding the vast differences between the conditions of its life in the sea and those of its antecessor on land, and the numberless generations of whales that have passed since its first appearance, still presents traces of organs fully developed in its four-footed antecessor, but which the whale itself does not possess.

We have now, thanks to the microscope, traced the process of specific variation to the womb of the first progenitor of a new race. The microscope cannot as yet take us further, and tell us of a difference between the germ-plasms of the antecessor and the successor, but, from the difference between the phases of their embryos, we see that there must be a difference between their germ-plasms, and may infer that variation arose in the germ-plasm. We may also imagine that the modification was effected by fecundating with a new force a fecundated ovum of the ancestor, and that

in this manner was produced a new specific life-force that evolved a new type.

The phases of the embryo thus disclose the open secret, of the manner in which successive types in the evolution of life came into existence.

But what of two forces and their apparent conflict in the development of the embryo?

We shall most readily explain this seeming anomaly, and at the same time the processes of specific variation in the embryo, by the analogy between the loom of life and the Jacquard loom, of which we previously availed ourselves. (See chap. viii.)

The Jacquard loom, by means of two distinct combinations of force, manufactures automatically webs of very diversified and elaborate patterns. One combination of force, representing the General life-force of our theory, provides the motive-power and throws the shuttle—does, in short, the work of the ordinary loom; the other combination, representing the Specific life-force, is embodied in a mechanism (attached to what is an ordinary loom), that automatically guides the threads of the warp to throw up a designed pattern, by means of perforated pasteboard cards affixed to the face of a cylinder (so called). The cylinder revolving,

presents successively to the mechanism a series of cards, perforated to produce a certain design, and the mechanism is guided, by means of the perforations, to throw up the pattern they represent. To change the pattern, it is necessary to replace only such cards as would conflict with the new design, by others suitably perforated; the other arrangements of the loom may remain unchanged.

Thus if a Jacquard loom has been weaving damask tablecloths having a plain border, surrounding a twilled square, with a flower pattern within a disc in the centre, and the loom is required to manufacture a similar tablecloth, but with a pattern of shells in the disc instead of flowers, it would only be necessary to substitute fresh cards, perforated to produce shells instead of flowers, for the cards whose perforations would conflict with the new pattern. The loom, with the new cards adjusted on the cylinder, would begin to weave the border of this new tablecloth like the old, and also the twilled square, to the point where the disc pattern begins; the new cards would then begin to throw up the new pattern, while the loom would go on weaving as before the twilled square on each side of the disc,

until the cards of the shell pattern successively intervened: if the disc extended wholly across the square, the cards that form the square would gradually be wholly superseded. It is to be noted that the cards that produce the pattern on the disc do not simultaneously supersede those that weave the square, nor does the change in texture run in a straight line across the web, but gradually as the cloths differ.

If a new tablecloth is to have a different kind of square, the specific variation between it and the first would be greater, and the new adjustment of the loom would supersede the old at an earlier stage—when the border was completed.

If a simpler tablecloth—*i.e.*, less specialised than the first—is wanted, either the centre pattern or the twilled square, or both, may be dispensed with, and the corresponding arrangements of the loom would be omitted.

The appearance and the quality of the web—what might be called its "expression"—will depend on the energy and steadiness of the mechanism of the loom, and also on the material used, as well as sometimes on the state of the atmosphere.

The processes in the loom of life are closely analogous.

The same Specific life-force invariably evolves the same *type;* but, as in the web, its expression among individuals of the same race will vary with any differences in the energy of the life-forces, or in food, or in environment during growth to maturity. To evolve a new race, either more or less highly specialised, the Specific life-force alone is modified, and that only so far as necessary to produce the new type. The greater the specific difference between successive types, the earlier does the Specific life-force of the successor intervene to differentiate the embryos; and the less the specific difference, the longer does the similarity between the embryos continue until, in the case of some so-called varieties of a species, no difference can be observed between them at birth.

The analogy between the loom of life and the Jacquard loom is, however, not complete in one particular. No loom, as far as we know, has yet been devised that will unweave part of a web and replace it with a different pattern, as the loom of life eliminates incipient teeth in the embryo of the whale and substitutes whalebone; but, looking to what has been already achieved, who will venture to say that this feat may not also be within the compass of man's ingenuity?

We now see that in the growth of the embryo there is no anomaly, no two distinct forces, and no conflict. The Specific life-force of the race (in conjunction with General life-force) evolves the embryo in the appointed type, as the two combinations of force in the Jacquard loom weave the web, and throw up the appointed pattern.

We cannot see the process of adjusting the new combination (the Specific life-force) to produce the new type, or the forces that evolve the successive phases in the embryo, but we can see that there must be forces to bring them about, just as surely as we see the force of gravitation in the fall of the apple.

Our theory has now explained—intelligibly, as we think — the existence of fragmentary organs and the significance of the phases of the embryo as completely as Huxley demands of a hypothesis. We believe it will also explain the other admitted facts of evolution; but if there is a single fact which, in the words of Huxley, "can be shown to be inconsistent with (not merely inexplicable by, but contrary to) the hypothesis," we freely admit that our theory "falls to the ground—it is worth nothing."[1]

[1] Darwiniana, p. 463.

If, however, our theory is sound, it follows—

That, the process of specific variation of mammals was completed in the womb of the first ancestor or of the immediate antecessor of a race, and that the process is repeated in the embryo of its latest descendant;

That, as every race reproduces a germ-plasm the same as that from which it came, type cannot be modified by any change in the corpus of the organism brought about by conditions, external or otherwise, or by accumulation of beneficial differences; and

That Type is immutable.

CHAPTER XII.

ARGUMENTATIVE.

We do not propose to anticipate arguments against this new theory of evolution, but we may examine two obvious objections.

This, it will be said, is merely the old theory of successive creations, according to which every new species was evolved by a "miracle" or by a direct intervention of "Supernatural Power."

Our theory does not assume, in the evolution of new species, any intervention of Supernatural Power different in principle from that which brought into existence the simplest forms of life.

If it is held that life was evolved by forces that previously existed in matter, then matter must have been endowed with properties that produced life. We cannot escape from a First Cause.

But what is a "miracle"?

A phenomenon, apparently at variance with some law of Nature we think we

understand, or something inexplicable by any law of Nature of which we have any knowledge, is, we presume, a "miracle."

Huxley says, "A phenomenon is explained when it is shown to be a case of some general law of Nature."[1]

Is, then, a phenomenon we cannot explain a miracle so long as it is inexplicable, and does it become "a case of some general law of Nature" when it can be explained? Was it a "miracle" that water should rise above its level into a vacuum before Torricelli explained the nature of a vacuum, and afterwards only a case of some general law of Nature?

Again, is an inexplicable phenomenon that frequently occurs not a "miracle" but only "a case of some general law of Nature" because of its frequent recurrence? We do not understand why a grain of seed germinates and grows into a plant, but we do not call germination a miracle, but "a case of some general law of Nature."

Why, then, should it be a "miracle" and not some "general law of Nature," that specific variation arose in the germ-plasm, seeing that we can witness the processes of variation in the embryo of every mammal, as we can those of germination in the growth of every seed?

[1] Darwiniana, p. 57.

We cannot see the force that causes variation in the embryo, but neither can we see the force that causes the grain of seed to germinate, or that brings the apple to the ground.

But it may be argued, that as it is an admitted fact that types more or less highly specialised succeeded each other, the Supernatural Power that caused the variation must have intervened after the simpler forms of life came into existence, and for that reason the intervention was miraculous.

But although Evolution, so far as we know, ceased when man, the most highly specialised organism, appeared—is there any ground for assuming that the Power that brought into existence simple forms of life did not also evoke the more highly specialised types that succeeded them, or that organisms when called into being were not, and are not still, sustained during life and reproduced by the Power that evoked them?

Whence or how comes the inexhaustible supply of force that sustains or renews all animated Nature?

The Darwinian problem—Given the existence of simple forms of life, how were complex forms evolved from them?—assumes that there was a difference between the coming into existence of simple and of complex organisms, and that life exists independent of

its Author; but for these assumptions there is no warrant in Nature.

Again it is objected, that to assume that beings were created imperfect is derogatory to the highest conception of an all-wise and omnipotent Creator.

If this objection were well founded it would follow that man—if he is the highest possible specialisation—would be the earth's only inhabitant.

But the objection is based on a confusion of ideas. If a clockmaker purposes to construct a perfect clock to register minutes only, and if he should succeed in producing a clock that marks and registers minutes correctly, is not the clock perfect although it does not register seconds, and has not the clockmaker accomplished his purpose?

And so, if the purpose of the First Cause was a world of life that should maintain existence for a space and reproduce successors, has not the purpose been accomplished?

But who knows the purpose of the First Cause?

The world, and what it comprises, is the manifestation of His purpose, and what it is we can hope to know, only when we fully comprehend the manifestation.

CHAPTER XIII.

INFERENTIAL.

Guided by the clue presented in the phases of the embryo and in fragmentary organs, we have learned to decipher the open secret of evolution, but these phenomena seem to have a wider and far higher significance than merely to disclose its path.

Consider for a moment the transformations and adaptations of organs that take place in evolving the organisation of a new type from that of its antecessor, as revealed, for example, in the embryos of the calf and of the whale. The upper incisor teeth of the antecessor begin to be developed in the embryo of the calf, but as teeth are not suitable for the conditions of its life, their growth is arrested; the incipient teeth will, however, form a satisfactory base for the hard pad, suitable for cropping grass, that is to cover them, and they are utilised in the new structure.

But the incipient teeth, similarly developed in the embryo of the whale, would interfere with the growth of whalebone, necessary to collect the food of the successor, and they are absorbed, and leave no trace in the mature animal that they ever existed. Then the bones and integuments of the fore-legs of the antecessor are transformed into fins, and a powerful tail is substituted for hind-limbs. Thus the organisation of the antecessor, that lived on land, is modified to adapt the successor for a life in water. Observe, however, that fragments of thigh-bones, six to nine inches long, in an animal whose length may be sixty to eighty feet, are found imbedded in its flesh disconnected from the skeleton. These fragments of the antecessor's organs were developed in the embryo of the successor, before the differentiation between the old type and the new was wholly completed, and they remain, apparently useless to the animal,—possibly for the purpose we are presently to suggest.

Common-sense, basing her conclusions on observation and experience, has no hesitation in accepting these marvellous modifications as evidence—we had almost said conclusive evidence—that adaptations so cunning were devised by Intelligence that foresaw the new

conditions of the successor's life, and were effected by Power that could command the forces that evolved them.

But why are incipient teeth formed in the embryo of the calf and adapted to a different purpose? why, in the embryo of the whale, do incipient teeth appear merely to disappear? and why are fragments of thigh-bones, apparently useless, left in its body? It is not to be conceived, that the Power that transformed the organs of the antecessor could not have so adjusted the new Specific life-forces that no trace of teeth should have appeared in the embryos, and no fragments of hind-legs in the body of the whale? In that case the transformation would have been more complete,—humanly speaking, a better finished job,—and no trace would have been found in the successor of the modifications that show whence it came.

What, then, is the purpose or what the object of these imperfections or flaws, if we may so call them? Do not these singular phases, cognisable in the embryo to the eye of science, and fragments of organs, patent in the corpus to the unaided senses, suggest the idea that their purpose is, like footprints in sand or straws dropped in a

maze, to demonstrate the existence of a First Cause as well as to disclose the processes of creation?

Elusive Nature, with purpose inscrutable, leaves in her operations no direct evidence of external intervention: cause and effect seem to follow each other automatically, but here and there are hieroglyphs inscribed on Nature's works that, rightly interpreted, reveal an omniscient and omnipotent Creator.

PART II.

CHAPTER I.

THE DARWINIAN THEORY OF ORGANIC EVOLUTION.

NOTWITHSTANDING the dissent of many eminent authorities, the theory of the Evolution of species by natural selection, made public by Darwin in 1859, still holds the field, and as a comparison of his theory with that in the preceding pages will tend to disclose their respective values, we now proceed to set forth Darwin's views as we gather them from his works, and to examine impartially, if possible, the evidence and arguments adduced in their support.

It would be beyond the scope of this work to examine exhaustively all Darwin's writings on evolution, and we shall therefore deal only with the more important phenomena referred to by him, and his interpretation of their meaning.

Darwin nowhere offers any views respecting the origin of life, nor does he formulate

his theory, but, assuming the existence of life in its simplest forms, sets forth at great length the facts and arguments, which he says have thoroughly convinced him—

That all animals and plants have been evolved from a few progenitors, and possibly from one prototype only.

That new species have been evolved principally by natural selection, acting through the struggle for existence; aided (*a*) to an important extent by the inherited effect of the use and disuse of parts, and (*b*) to an unimportant extent by the direct action of the external conditions of life.

That small beneficial differences appeared from time to time in some members of a species, and, being accumulated by heredity through numberless successive generations, during vastly extended periods of time, ultimately became specific variations, and thus new species arose.[1]

The principal phenomena adduced in support of these conclusions are—

The similarity in structure and organisation of successive types.

[1] See 'Origin of Species,' Ed. vi., p. 421.

The differences among animals of admittedly the same race.

The known effects of (*a*) selective breeding, (*b*) the use or disuse of parts, and (*c*) the direct action of external conditions of existence.

We propose first to define what we mean by a "race," and then to examine in detail the real meaning and significance of the phenomena to which Darwin appeals, and also the value of the arguments based on his interpretation of these phenomena.

CHAPTER II.

RACE.

The term "species" is unsatisfactory, especially in discussing the problems of evolution.

"Species" is a purely artificial distinction, and has no definite significance. It has been said by some authorities that species is determined by practical experience and common-sense.

While, therefore, species may serve for purposes of classification, its meaning in discussing the origin of species is too indefinite.

According to Quatrefages, a species includes all more or less similar individuals which descend, or can be supposed to descend, from a single ancestral pair in unbroken succession. But many species include varieties that permanently differ from each other, but not, in the opinion of naturalists, sufficiently to constitute a distinct species. The difference necessary to constitute a

distinct species is thus a matter of opinion, and authorities occasionally disagree in their classification.

But in questions of evolution, it is of cardinal importance to determine whether a variety is merely an unusually wide divergence in expression of type, or a distinct type, or, as Darwin holds, a new species in the course of formation.

We must therefore seek to find some characteristic or test, that shall determine whether two closely allied groups are distinct races, or merely varieties of the same race, that may, with opportunity or altered conditions of existence, merge into one.

The test we propose of a distinct type or race is, that its members shall not only be alike in appearance and fertile among themselves, but that their progeny shall continue fertile and the type persistent.

If the members of a variety (so called) are fertile together and their stock persistent, it is a distinct type or race. But if the members of a variety, although fertile among themselves, cannot maintain their type for at least three generations, it is an intermediary between two races, and not a distinct type or race.

We believe that unless at least one parent

is of pure or nearly pure blood, the stock will not be permanent.

A herd of hybrids, for example, cannot, *within themselves*, perpetuate a stock intermediate between the two pure races from which they came.

The proposed test is quite practicable in the case of domestic animals, and with them its value may be ascertained in a few years.

We do not know that experiments of the kind suggested have been made purposely, but our propositions are based on the uniform experience of breeders.

Cross-breeding of domestic animals has been diligently pursued during the last century, and yet there has not been produced a permanent stock intermediate between two pure breeds. Every cross-bred stock has died out, unless bred into a pure race, by continuous mating with pure blood.

Several breeds of cattle are very closely allied to each other, and a new breed intermediate between some of them would certainly have been produced if Nature did not prohibit persistent intermediaries. The profit that would arise from an intermediate breed of cattle, that combined the excellences of two races—*e.g.*, high capacity

for producing both milk and meat, or high quality of meat with early maturity—has induced numberless efforts to establish intermediate breeds, but all have failed.

Shorthorn cattle are specially valued for early maturity, and polled Aberdeenshire for high quality of beef, but they are longer in coming to maturity than Shorthorns. A cross between the two usually combines the advantages of both — early maturity and excellence in quality of meat—and is thus more profitable to the grazier than either of the parent breeds. Farmers have in consequence anxiously endeavoured to establish an intermediate breed that would combine the two qualities, and if their efforts had been successful—that is, if the intermediate type had proved persistent—a new breed or race would have been established. But all attempts in this direction have signally failed. The mongrels from the hybrids invariably proved degenerate specimens—inferior to their pure ancestors in expression of type and also weak in constitution—and so they disappeared, either through sterility or debility. Darwin cites, as already mentioned, experiments with eggs of cross-bred fowls, where nearly all the few chickens that emerged from the shell died soon after,

"without any cause" or "apparently from mere inability to live." The same results follow the cross-breeding of dogs. The lurcher is a cross between the greyhound and the collie, and combines in high degree the swiftness and keenness of vision of the greyhound and the intelligence and scenting faculty of the collie; but no breeder thinks of breeding lurchers from lurchers, because the degeneracy of their mongrel progeny is well known.

It is not easy to see how varieties of the same species can exist in the same locality. According to the common standard of fertility, all are fertile together, and if so, all would by heredity become blended together in expression, and variety would cease. In our opinion, varieties in the same locality are distinct races, kept pure by that aversion between races that we know exists without any satisfactory explanation—unless to preserve purity of race—between different races of mankind, and very notably between some species of lower animals.

But it may be asked how the distinct breeds of pure cattle, now registered in their respective herd-books, have appeared within the last century? Are they not examples of new varieties?

There is no doubt that all the different breeds of cattle or of sheep that now exist, existed in herds more or less pure before selective breeding was practised. Then as now, the animals varied among each other in size, shape, and quality, and the history of any pedigreed breed tells us that the breeder, by continuously selecting the best animals in his herd for breeding purposes, and by protecting them in their struggle for existence, developed the breed and established its reputation, by demonstrating what could be done by careful selection and generous treatment. No breeder ever created or made a breed—the breed existed from all time; he, simply by following, probably unconsciously, Nature's method of maintaining purity of race, as explained in a preceding chapter, purged his herd of any strain of impurity, and by generous treatment secured a full expression of the type. There is no specific difference between pedigreed animals and those of the same breed, whose ancestors never appeared in the herd-book.

If then, as experience shows, it is impracticable, either by cross or by selective breeding, to establish a new variety between two closely allied races, or within a pure race, does it not follow that every group

of animals that perpetuates its stock has always been a distinct type, and that any differences among individuals of the same race are merely different expressions of its type?

CHAPTER III.

SIMILARITY OF SUCCESSIVE TYPES.

One of the strongest arguments in favour of the Darwinian theory is based on the similarity in structure of successive types.

In many cases the skeleton and general organisation of the antecessor and of the successor are all but identical, and in every case the embryo of a successor presents, during its growth, phases similar to what may be observed in that of its antecessor. Indeed, in some instances — some breeds of dogs, for example—the young of the successor and of the antecessor cannot at birth be distinguished from each other, and the specific characteristics of the successor are only developed between birth and maturity.

Seeing that the differentiation, between an antecessor and a successor, begins invariably at the same stage in the growth of their embryos, may we not naturally infer that the differentiation is due to new forces in the

successor that come into action at that stage and differentiate the types? And the question is, How or whence come those differentiating forces?

Darwin says the differentiation is caused by changes in external conditions of life, or by the accumulation of beneficial differences that "spontaneously" arise.

But we cannot see how external influences, sometimes destructive, can become constructive and evolve higher specialisation, and before any argument can be based on "spontaneous" variation there must be evidence of such variation. But Darwin offers no evidence of persistent specific variation.

Specific variation between a successor and its immediate known antecessor is sometimes great, and the similarity between phases of their fœtus is only observable in the early stages of growth. In such cases the mature animals are very dissimilar: the foundations, so to speak, are alike, but the superstructures are very different. The difficulties of evolution, by secondary causes, are more obvious in such cases, but they are not really increased by the width of the gap between antecessor and successor. The difference is in kind, not in degree.

Darwin attributes these gaps to the imperfection of the geological record, and believes they will be filled up by future discoveries. But even then the difficulty would not be removed, because, as we have seen, the same objection applies in principle in the case of the smallest gap—for example, where variation arises only after birth.

Further, the argument based on the similarity of successive types is negatived by the facts of retrogression—that is, where the successor is less highly specialised than its antecessor. But we discuss retrogression in another chapter.

The generally higher specialisation of successive types, and the position of their respective fossil remains in successive geological strata, we accept as conclusive evidence of a process of evolution, and their similarity suggests the idea that there is something in common between them; but similarity does not prove that the one was evolved from the other by secondary causes. To infer that the steam-engine of to-day was evolved from the first machine of the kind, without human intervention, would be an absurdity unworthy of notice, and the difference between a mammal and a fish, to go no lower, is far greater than between any steam-engines.

We know that the materials of the first engine did not of themselves combine or take thought to become an engine, and we know that every successive improvement or step in its evolution was effected by the active intervention of the intelligence and power that fashioned the first. May we not then conclude, at least until we have some evidence to the contrary weightier than mere inference, that the process of evolution was in many respects analogous to the development of the steam-engine, and was not brought about by secondary causes or by "spontaneous" variation?

If we are to speculate on the matter, it seems to us in accordance with common-sense, and what we know of Nature, to believe that the Creative Power that first brought life into being, continued to intervene in evolving, with purposes we may try to imagine but can never know, a scheme of evolution, whereof part was the production of new types more or less highly specialised, by a method that utilises, as man, unconsciously following the example, utilises, a realised conception in evolving a new.

CHAPTER IV.

THE STRUGGLE FOR EXISTENCE AND NATURAL SELECTION.

Life, under favourable conditions, is not a struggle, but the harmonious development of an organism. When, however, development is obstructed or impaired by unfavourable conditions, life does become a struggle, and as every species of animal (civilised man perhaps excepted) and plant tends to increase faster than the food available for subsistence, the conditions of life become unfavourable, and the struggle for existence all-pervading, save where man intervenes. The survivors in the conflict thus inevitable, will have proved themselves fitter to exist than those that perished, presumably because they possessed some advantage over their less fortunate fellows: when the struggle was nearly balanced, that advantage may have been of a trifling character, but, according to Darwin, minute differences are accumu-

lated by the effects of the struggle and by heredity, and thus ultimately a new species is evolved.

But although the animals that survive have evidently proved themselves fitter than those that succumbed, that does not prove that they are fitter than if there had been no struggle, or that they themselves are as fit as when the struggle began.

Let us suppose a colony of fifty rabbits on an island capable of sustaining not more than a hundred without a struggle for food. While grass is abundant, and the conditions of life are in every respect favourable, the rabbits multiply, and in a few generations the highest expression of their type will probably be developed. But when the colony exceeds a hundred, the struggle for existence will begin and go on continuously.

What will be the result of the struggle after six months have passed? The rabbits that possessed the greatest vitality, and were able to live on the smallest quantity of food, will have proved themselves fitter than those less highly endowed, and will survive; whilst the feeblest, when the struggle began, will have been starved out of existence. But have the surviving rabbits come out of the struggle unscathed?

Have they become fitter to continue the struggle than the rabbits that were fittest when the struggle began? Or, should the struggle develop into a conflict between individuals, will the half-starved rabbit be as fit to fight as when he was well fed? Were that the case, it would follow that scarcity of food is more favourable to life and vigour than abundance; but that is absurd, for we know that insufficiency of food impairs constitution and vitality and stunts growth. The differences between wild and domestic animals, assuming both to be of the same species, or between the same plant growing wild and under cultivation, are obviously not the effects of the struggle for existence, but of protection from its effects.

In the case of animals that live by preying on other species, it may be argued that, when food ceases to be abundant, increased use would develop in exceptional individuals increased speed of foot or wing, or keenness of vision, as the case may be; but the habits of beasts or birds of prey do not support this conclusion. The beast or bird of prey gorges itself when it has the opportunity, and does not again hunt its prey until impelled by hunger. Habitual necessities thus provide sufficient exercise for the full development of

the muscles. If the prey become less abundant, more exertion must be expended on its capture. There will be more exercise to develop the muscles, but there will be no more food to sustain them; and if endurance be developed, it will be at the expense of some other part of the animal economy. Should the struggle for food become intense, the vigour of the strongest must become impaired, and the weakest perish. And so the experienced hunter of big game knows that where food is scarce he will get little sport and no fine specimens.

But there is no need to rest our conclusions on hypothetical illustrations. A struggle for existence, on a great scale, has been going on in Australia for the last five years, and forty millions of sheep, it is officially reported, have succumbed in their struggle for food and water. Five years ago there was no struggle for existence on Darling Downs—grass and water were there in plenty, and the flocks were as fine as any of their breed. And now the wretched creatures, dying by the way, or selling at a shilling a-head, are the remnants that have survived in the terrible struggle. And how do the fittest of them compare with the flock of five years ago? Has any beneficial variation appeared during the prolonged

struggle among the many millions exposed to its effects? The question, in presence of the sheep, would be ludicrous, and common-sense asks, How could beneficial variation be expected from depletion and exhaustion, to which the struggle for existence invariably tends? The flock-master will tell you that the fittest of the survivors is not equal, in any respect, to the unfittest in the flock five years ago, and that the sheep born during the struggle will never equal the old flock; for bitter experience has taught him that an animal that has suffered from unfavourable conditions in its youth will never, however carefully protected afterwards, become a fine specimen of its breed. The finest animals are produced only by continuous careful protection from their birth upwards.

If beneficial variation did in some mysterious manner arise, its possessor would no doubt, in the struggle for existence, probably outlive its fellows. But there must first be the beneficial variation, and of such there is no evidence. Mr Bateson in his work 'On Materials for Variation' does not record among deviations from a normal type—what we call accidents in the loom of life, or monstrosities — a single example of *beneficial* variation; and, considering the exhaustive

character of his work, it may be fairly assumed that no example of the kind is known.

It may be argued that the Australian struggle is a very extreme case, but, if the struggle for existence is a stimulus to beneficial variation, it might be expected that the more severe the struggle the greater the stimulus would be, or that at least some evidence of a tendency thereto would be disclosed. The magnitude of the result in Australia only makes more conspicuous the absurdity of the contention, that any beneficial variation can come from the struggle for existence.

We can now clearly recognise that the real function of the struggle for existence is to eliminate the unfit, and thereby to limit degradation of type, as, on the other hand, sterility and precocity limit development.

Natural selection—the name given by Darwin to the outcome of the struggle for existence—does not select in the ordinary acceptation of the term. If it does select, it selects for death and not for life, and although survivors in the struggle may benefit by the competition for food becoming less severe,

would not the benefit be greater if there was no competition—no struggle?

The idea that the struggle for existence—that is, unfavourable conditions of life—has a developing influence on animal physique, has probably been suggested by the great development of the moral strength of man under his struggle with adversity; but there is no analogy between the effects of unfavourable conditions of life on animal physique and of adverse circumstances on the moral nature of man.

CHAPTER V.

THE ACCUMULATION OF BENEFICIAL DIFFERENCES.

We fully recognise differences among individuals of the same race, and also that such differences are specially noticeable amongst domestic animals under selective breeding. Some individuals, compared with their fellows, develop what we consider beneficial differences; and the assumption by Darwin that these beneficial differences accumulate indefinitely, become specific variations, and give rise to new species, is a main prop of his theory.

The hypothesis seems at first sight plausible enough, and, had evolution been brought about by secondary causes, it is possible that the accumulation of beneficial differences might have been an effectual means of developing new species.

But, unfortunately for Darwin's hypothesis, the beneficial differences that arise under

selective breeding do not tend to specific variation, neither does their accumulation go on indefinitely, for experience tells us that the maximum accumulation of beneficial differences may be attained within three generations, and that retrogression then takes place—either the beneficial differences disappear, or sterility bars further accumulation.

Galton, in his work on Hereditary Genius, seems to have proved, by carefully collected statistics, that eminent intellectual and also great physical ability run in families, and are therefore more or less hereditary; but we do not think his statistics present any example of a father, son, and grandson possessing abilities above the average of the family, and in every case the eminence subsequently disappears.

"Ability," says Galton (p. 76), "in the long-run does not suddenly start into existence and disappear with equal abruptness, but rather it rises in gradual and regular curve, out of the ordinary level of family life. The statistics show that there is a regular average increase of ability in the generations that precede its culmination, and as regular decrease in those that succeed it. After three successive dilutions of blood,

the descendants of the judges appear to be incapable of any eminence."

And his statistics of the families of great wrestlers and oarsmen show, that fathers may have distinguished brothers or sons, but no grandsons above the average.

We do not think that Galton's statistics prove "a regular average increase of ability in the generations that precede its culmination." Sometimes pre-eminent ability suddenly appears in a single individual or generation (amongst brothers and sisters), and disappears with the individual or generation. Pre-eminence seems to be attained within two generations, and declines in the third; but if either the son or grandson was not pre-eminent, the fourth generation may still be above the average.

There is no clue to the origin or cause of pre-eminence; it springs up in wholly unexpected quarters, and if it most frequently appears in gifted families, it also sometimes arises in families otherwise unknown to fame.

The case is similar among cattle and horses. Neither selection nor protection from the struggle for existence will ensure pre-eminent excellence, although protection is necessary for its full development.

We have no statistics of cattle or horses, but it is well known that many exceptionally fine animals left no immediate descendants equally good, and it is well established that there were as fine cattle and horses ten generations back as there are to-day; proving perhaps as fully as such questions can be proved, that the accumulation of beneficial differences is strictly limited.

Development cannot, as we have said, exceed a full expression of the life-force of the race.

Galton seems to have been struck by the rapid extinction of the peerages gained by eminent lawyers, and thinks it was because the peers married heiresses—as it appears from their family histories the most of them did. The mere possession of fortune could not affect fertility, but it may be inferred that a great heiress was the last of a high-bred family, or the daughter of a man of pre-eminent ability in some direction, and that high breeding, or the pre-eminence of the father or of the judge himself, not the fortune, was the reason why the peerage became extinct.

The statistics collected by Galton go to prove that there is a cycle of development and retrogression, that the development above

the average does not exceed three consecutive generations, and that their descendants —if they have any—sink below it. These conclusions point to a natural law, that differences among individuals of the same race or family oscillate round an average type of that race or family, and that the oscillation above the average is complete in three generations.

The average of a type may be raised by improving the conditions of life of the mass of its members, but the average only approaches nearer to the maximum—the maximum itself cannot be raised.

In all this we cannot find any support to the hypothesis, that beneficial differences are accumulated indefinitely, and become specific variations. On the contrary, all statistics confirm our previous conclusions, that the accumulation of beneficial differences does not go on indefinitely—that the maximum is reached within three generations, and that retrogression then follows.

When we try to imagine the results to mankind, if intellect or physical strength accumulated in a family—if, for example, the genius of a Napoleon, or the strength of a Sandow, accumulated in their descendants

— we clearly recognise that a *bouleversement* of society would quickly follow accumulation, and that, as between the two methods, development, followed by retrogression, and not accumulation, is Nature's law in heredity.

CHAPTER VI.

THE TIME ELEMENT.

The vastly extended period of time that has elapsed since life first appeared on our globe, is a principal factor in the theory of natural selection.

Beneficial differences, originally small, accumulating through numberless generations, became specific variations, and thus new species arose, — so Darwin argues plausibly enough,—and we must examine the bases on which the argument rests.

In the first place, time effects nothing. Time merely gives opportunity for dormant forces to come into action, or for forces in action to develop results. Lapse of time could not therefore, of itself, aid natural selection.

In the second place, there can be no accumulation if there is nothing to accumulate.

Darwin appeals to the differences between animals of admittedly the same race, and

argues, Why should not these differences accumulate indefinitely by heredity, and in the course of numberless successive generations give rise to new species?

But we have shown—

That these differences are not differences in type, but merely in expression of type, and are only such as must necessarily arise from inherited differences in vital force, and in conditions of existence, including food;

That these differences are strictly limited, on the one hand by sterility or precocity, and on the other by death in the struggle for existence. They cannot, therefore, increase indefinitely;

That these differences may attain their maximum within two or three generations, and an extended period of time is therefore not necessary for their full development; and

That the maximum of these differences discloses no tendency to specific variation.

The differences among individuals of the same race represent only a more or less full expression of the Specific life-force of that race.

Palæontology, while it demonstrates that evolution proceeded by successive steps, gives

no support to the hypothesis, that the successive steps resulted from accumulation of beneficial differences, or were caused by some force within the organism, or by external influences.

Fossils of various organisms, found in primary formations, are in appearance the same as species that still exist; and as they lived unchanged through more than one geological epoch, during which they were subjected to great variations in the conditions of their existence, we conclude that, if variation were a principle inherent in life, or if specific variation could be brought about by external conditions, these persistent races should present some evidence of the effects of the great changes through which they passed. But as they remain unchanged, we are entitled to conclude that type is persistent in organisms generally, and cannot be specifically modified by external conditions; or that some organisms are modified by changes in the conditions under which they live, and that others are not. But this alternative would be at variance with the homology that pervades Nature.

Again, if we consult historical evidence, we find that the representations of animals in the Egyptian tombs 5000 years old also

represent existing species. These figures show no specific variation or any tendency thereto, although more than 200 generations of men, and 2000 of most of the other animals represented, have passed since they were depicted. No doubt 5000 years is but a small fraction of the existence of life on our globe, but we have a far longer experience. According to Darwin, new species did not arise *per saltum*, but were slowly evolved by the accumulation of small beneficial differences that from time to time appeared, aided by secondary causes. Specific variation has thus been in progress since the beginning of the present geological epoch, and, we may infer, in many species, if not in all. There ought, therefore, to be many examples of new species in various stages of development. But neither naturalists nor biologists have discovered any transitionary forms such as the Darwinian theory demands.

So far, therefore, as there is evidence, it is against the hypothesis that specific variation has arisen during vastly extended periods of time.

CHAPTER VII.

RETROGRESSION.

The geological record tells us that, as a rule, the evolution of life proceeded from simple forms to more complex—from less to more highly specialised organisms; but to this order of progression there are numerous exceptions.

Of these exceptions we propose to deal with two only, but they fully exemplify the problems involved in retrogression.

An antecessor of the snake was the lizard, an animal provided with four legs for locomotion: the snake has no legs and crawls on its belly. It is thus much less highly specialised than its antecessor. Externally the snake has no trace of limbs, but some species have humeral bones still attached to the skeleton, in others the limb-bones have wholly disappeared.

On the other hand, the number of the snake's vertebræ has increased.

Evidently the snake did not come from the lizard by accumulation of beneficial differences, and common-sense will not entertain the idea that the limbs and even their bones wholly disappeared by disuse, or that the additional vertebræ came by excessive use, or that these transformations were brought about by changes in conditions of existence.

An antecessor of the whale was a four-legged land animal—a mammal, and the whale remains a mammal; but its fore-limbs have become converted into fins, and the hind are replaced by a huge tail. The whale is thus well adapted for a life in the sea instead of on land, but his organs of locomotion are less highly specialised than those of the four-legged antecessor.

Is it possible to conceive that transformations so great—one pair of legs into fins and the other pair into a tail—could have been brought about by natural selection, accumulation of beneficial differences, use or disuse, or changed conditions of existence?

How, then, does Darwin's theory explain these changes?

So far as we can find, neither he nor Huxley attempts any explanation, or indeed refers to the very remarkable retrogression in

the structure of the snake or of the whale. Darwin does attempt to explain by disuse the sightless eyes of some fishes found in caves, but on the much more signal degradation of the snake and the whale he is silent.

Huxley indirectly suggests a solution[1] by extending the doctrine of the struggle for existence to the molecules in the germ-cell. "It is a probable hypothesis," he says, "that what the world is to organisms in general, each organism is to the molecules of which it is composed. Multitudes of these, having diverse tendencies, are competing with one another for opportunity to exist and multiply, and the organism as a whole is as much the product of the molecules which are victorious as the fauna or flora of a country is the product of the victorious organic beings in it. On this hypothesis hereditary transmission is the result of the victory of particular molecules contained in the impregnated germ."

Expression of type may possibly be the result of the victory of the Specific life-force of either parent in a competition for the control of the molecules that determine expression, but that, if we are disposed to consider such

[1] Darwiniana, p. 115.

speculations, is very different from a conflict between the molecules themselves; for in this case we might expect the frequent appearance of animals with diminished organs, and others with theirs enlarged.

The hypothesis is developed by Professor Weissman in his 'Germinal,' where he recognises that neither natural selection nor varying external conditions of existence will wholly account for degradation.

"Germ-plasm," he says, "must be altered —the whole vital particles of which it is composed"; and again, "Neither natural selection nor varying differences of life will wholly account for variation, which is completed by profound processes of selection in the germ-plasm."

This he calls "Germinal Selection."

The necessary modification is brought about by what Professor Weissman calls "determinants," "that appropriate nourishment in the germ-plasm for the particular organs they produce—each battles stoutly for its food, the stronger appropriates part of the share of the weaker neighbours, who ultimately disappear, and with them the part of the organism they represent."

Applying this doctrine to the case of the snake, the "determinants" of the organs of

locomotion in the germ-plasm of the antecessor were not sufficiently powerful to appropriate their share of nourishment in the germ-plasm, and so the organs of locomotion ultimately disappeared, and if we assume that the "determinants" of the backbone were the robbers, the increased number of the vertebræ would be accounted for. But this extraordinary hypothesis, for which Darwin is not responsible, does not explain how the fore-legs of the whale were converted into fins, nor how the hind-legs came to be replaced by a tail.

Huxley says:[1] "Every hypothesis is bound to explain, or at any rate not be inconsistent with, the whole of the facts it professes to account for; and if there is a single one of these facts which can be shown to be inconsistent with (I do not merely mean inexplicable by, but contrary to) the hypothesis, the hypothesis falls to the ground—it is worth nothing."

Common-sense reviewing the facts of retrogression must, we venture to assert, come to the conclusion that the Darwinian theory not only does not satisfactorily explain, but is at variance with, the phenomena.

[1] Darwiniana, p. 463.

CHAPTER VIII.

VARIATION.

From our observations of animals we may safely conclude that no two are absolutely identical.

The differences are of three distinct kinds :—

The difference among animals of admittedly the same race. This we call "Variation in expression of type";

Deviation (also among animals of the same race) in one or more parts from the normal type. This occurs but rarely, usually in a single individual, and is not hereditary. This difference may be called "accidental" (? spontaneous) variation; and

Persistent hereditary differences between two races—viz., specific variation.

As usual in Nature, no hard line can be drawn between these different classes, and in some cases it may be difficult to determine

the category to which a difference belongs. In the human species, for example, it is sometimes impracticable to distinguish between variety of expression and the specific variation that indicates a distinct race.

Variety of Expression.

We are all familiar with the infinite variety of expression, both in face and figure, among individuals of the same human race, and we all recognise that a particular expression may be more or less hereditary in a family. We also know that a family expression may be more or less affected by the conditions of existence of the individual. But common-sense tells us that these differences of expression do not indicate any tendency towards specific variation. Careful observers may also detect similar differences of expression in the same breed of domestic animals, and even of wild species. But, as Darwin points out, the differences among domestic animals of the same race, and especially those that arise under what is called "selective breeding," are much greater than among wild species.

When, however, the differences between the best and worst specimens of any domestic

breed are analysed, they resolve themselves into differences in respect of size, quality, or shape of certain muscles or bones. The two animals remain the same, or at least similar, in form, and no difference of a specific character between their skeletons or organs can be detected; but, on the contrary, the longer selective breeding is pursued, the more firmly established becomes even the family expression of a herd. The differences from the average type, induced by selective breeding, are only such as might be expected in the progeny of selected animals, provided with abundance of food and healthy comfortable conditions of existence. Again, as might be expected, wild beasts neither carefully selected for breeding, nor reared under exceptionally favourable conditions, show less divergence from an average type than protected domestic animals.

The greater differences among domestic than among wild animals probably arise, in part, because the former were endowed with an organisation of greater elasticity and flexibility, and in consequence respond freely to the influence of man.

It is assumed by Darwin and other naturalists that all domestic animals came from the closely allied wild species, but of this

there is no evidence. There is no record, ancient or modern, or even traditional, of the domestication of any wild species, and the origin of our domestic animals is enveloped in mystery. For this and other reasons Domesticity demands a separate chapter.

Accidental (? Spontaneous) Variation.

Individuals sometimes appear so different, in one or more organs, from their fellows of the same race, that they might fairly be claimed as specific variations from established types.

Such cases are, proportionately, extremely few, and deviation from a standard type is, with only—so far as we know—one exception, not hereditary.

Children have been born with abnormal hands or feet, and polydactylism, it is admitted, is more or less hereditary. These abnormalities are not confined to the human species, but occur also among cats, dogs, &c.

The loom of life is exposed to external interference that may involve complete failure, or some confusion in elaborating the details of a very complex web, and it may be that the Specific life-force has accidentally

suffered some trifling modification in the germ-plasm, or in the earlier stages of the embryo's growth, sufficient to produce polydactylism, which has thus become hereditary, or as much so as might be expected where one parent is normal and the other abnormal. But having regard to the marvellous complexity of the mechanism, and the delicacy of the forces that automatically build up the minute details of the organism, and to the accidents that beset the fœtus in its growth, it is surprising that deviations—"monstrosities"—are not more common than they are.[1]

[1] Since writing the preceding a very interesting case of polydactylism has occurred.

On January 7, 1903, an inquest was held by Dr W. Westcott, coroner for Shoreditch, respecting the death of Charles Nicholls, aged three days, son of William Nicholls, packer, residing at 24 Styman Street, City Road, London. The father stated that five or six months ago his wife was frightened by a fowl flying across her face, and fainted, but subsequently did not appear to have suffered from the fright. When, however, the child was born it had six fingers on each hand and six toes on the right foot, which had the appearance of a duck's. On the previous Friday the child was seized with convulsions and died before a doctor could be had.

Dr James Trevor Williams, who made an autopsy by instruction of the coroner, said that in addition to the external malformation, the internal viscera were imperfectly formed, due, in his opinion, to the fright of the mother.

Dr Williams, at my request, made further inquiries of the parents, and reported that they knew there had been no

But even if polydactylism be a specific variation and hereditary, it would not support the theory that new species arise by the accumulation of small beneficial differences; for neither polydactylism nor any other recorded deviation from a normal type arises by accumulation, or is of a beneficial character, or of any advantage to its possessor in the struggle for existence.

Mr Bateson, in his exhaustive work 'Materials for the Study of Evolution,' has catalogued many deviations from normal types; but after examining the illustrations, we cannot help coming to the conclusion that the deviations are all of the nature of accidents in the growth of the fœtus,—monstrosities that arise and disappear with the individual.

Deviations are therefore no evidence of

polydactylism in the father's family for four, nor in the mother's for three, generations. In his opinion they were truthful, and did not seem to have any motive to be otherwise.

We have here, it may be assumed, the origin of a case of polydactylism, and may infer that it was caused by some accident to the fœtus when two or three months old—the mother was not certain about the exact date.

This case seems to suggest the possibility of modifying type by an operation on the germ-plasm, and as polydactylism is hereditary, it is possible that if a germ-plasm could be modified, the resulting specific variation might be hereditary. —J. W. B.

specific variation or of any tendency thereto. The Siamese Twins were a specific variation, but common-sense cannot accept such monstrosities as evidence of the evolution of a new species.

There was recently to be seen in Bristol a mare born minus a foreleg and shoulder; she was nevertheless reared, and, as certified, had produced three foals, two of them winners of prizes for fast trotting, demonstrating in the most conclusive manner that her deviation from the normal type neither was transmitted to her progeny, nor indicated any tendency to specific variation.

Specific Variation.

We have now to consider those differences in structure and organisation that are the distinguishing characteristics of distinct races, and constitute "specific variation."

According to Darwin, specific variation originated in slight beneficial differences among members of the same race; and these differences accumulating, chiefly by the effects of the struggle for existence, during numberless successive generations, ultimately formed new species. Speaking metaphorically, evolution advanced along

an inclined plane, and not by distinct steps or stages.

In this view successive types in the chain of evolution would be so much alike, that only the closest scrutiny could determine the differences between them or the order of their succession, and the geological record should show a continuous gradual development in specialisation. Further, the struggle for existence should, according to Darwin, have wholly eliminated the lowest types, as well as those intermediate between them and the highest.

Darwin himself admits the force of these conclusions. "Geology," he says, "assuredly does not reveal any such finely graduated change" as his theory involves; and again, "One [objection]—namely, distinctness of specific forms, and their not being blended together by innumerable transitional links—is a very obvious difficulty." [1]

Another difficulty he admits is the sudden manner in which several kinds of species have appeared in European formations.

These difficulties Darwin seeks to meet by supposing, that new varieties continually supplant and take the place of their parent type, which thus disappears, and by the ac-

[1] Origin of Species, Ed. vi., p. 264.

knowledged imperfections of the geological record; and expresses his belief that the gaps between different fossil types, which enable naturalists to classify animals into distinct genera and species, would be filled up by new discoveries.

It is remarkable, however, as Darwin himself points out, that no example of the gradual transformation of a single species into another has been preserved, even in deep strata whose formation must have involved enormous lapses of time, and also, that the less specialised animals, presumably not so well equipped as the higher species, should survive and exist at the same time as their more highly equipped successors.

The inconsistencies between his theory and admitted facts Darwin endeavours to reconcile — ineffectually, as we think; but his explanations are too long for quotation, and we must refer the reader to the 'Origin of Species' (chap. x.)

But leaving the dead past, we have, in an existing family of insects, a living record of the process of evolution far more instructive than could possibly be presented by fossil remains, however complete, because we can observe the specific differences not only in physique but also in the habits and instincts

of the different races, and these are more characteristic than differences in their organisation.

The family of the Bee comprises over 4500 distinct races, and as each represents a stage in development, the chain of evolution from the primitive to the hive-bee is composed of over 4500 links. It may therefore be accepted as practically complete. Now, every link in this chain is so different from its fellows that, as we see, naturalists are able to describe and classify each link. The races, therefore, do not blend into each other by imperceptible gradations, as would be the case if they were the outcome of small differences gradually accumulated; neither are there wide gaps in the chain, as there should be if the struggle for existence eliminated the less fully equipped intermediaries. Moreover, some of the specific variations clearly demonstrate that they do not come by an accumulative process; for some new genera have characteristics that are not found in the main line of evolution, either before or after these new genera appeared. These variations were, therefore, neither inherited from the primitive bee nor transmitted to the hive-bee.

This instructive feature in the evolution of

the bee is well illustrated by the instincts and habits of the Sphex of Languedoc.[1]

This race, resembling in appearance an attenuated wasp, neither constructs combs nor stores honey, but digs a hole in the ground and nourishes its offspring on fresh animal food, which the parent provides by capturing and semi-paralysing an insect much larger than itself, the Eppiphiger. Seizing its victim, the Sphex darts its sting into the thorax, where the poison reaches and paralyses the nerve centres of locomotion. The Eppiphiger, thus unable to offer any effectual resistance, is dragged to the bottom of a burrow hastily made by the Sphex, which then deposits its egg on a particular spot on the breast of the victim, closes the burrow, and departs. The egg hatches in two or three days, and the larva fattens on its semi-paralysed but living food, thus kept fresh, until, in ten or fourteen days, it is ready to spin a cocoon—a very complex structure—in which it passes the winter.

Complex instincts, Darwin says, are the results of the accumulation of numerous slight beneficial differences, whilst others are acquired habits, accumulated through many generations. But feeding its young on

[1] See 'Insect Life,' by Fabre.

animal food instead of honey, paralysing without killing its victim, and spinning a cocoon are habits antagonistic to those of the primitive bee, and therefore could not have been inherited, but must have come from some mysterious source — from what we call a modification of its Specific life-force.

Other genera allied to the Sphex display singular modifications of its wonderful instincts.

Thus the Ammophila, after digging a hole, covers the entrance with a small flat stone until it captures and returns with a paralysed caterpillar; it then removes the stone and drags its victim into its cell. Small caterpillars are paralysed sufficiently by a single thrust in the middle of the body, but the larger—sometimes fifteen times the size of the assailant—are stabbed in every segment before they are quiescent enough to do the larva no injury. Like the Sphex, the Ammophila, after depositing its egg, closes its burrow, and leaves never to return; but another variety, the Bembex, does not paralyse the food of its larva, and must in consequence return frequently to provide it with fresh meat. The cell is constructed in a slope of loose sand, and, when the insect leaves its

cell the loose sand rolls down and skilfully covers the entrance as with a curtain. Through this curtain the mother readily pushes her head on returning with food, which at first consists of small insects, no larger than the larva can wholly consume before they become high; then as the larva grows, larger insects are brought to meet its increased appetite. The loose sand covers the entrance of the burrow so skilfully that the human eye cannot detect the spot, although the mother has just left; but *she* has no difficulty in finding the entrance on her return with food. After a day's absence she will return to the entrance with the utmost precision, and push her head at once through the curtain. So wonderful has Monsieur Fabre found, by various experiments, the homing faculty of these hymenoptera, that he ascribes to them a sense of which man knows nothing.

Again, the Mason-bee does not dig holes, but constructs on detached stones or under eaves cells of calcareous dust made into mortar with saliva, and feeds its larva on honey and pollen mixed into a paste, with its mandible for a spoon. With this paste the cell is stored; an egg is then laid on the top, and the cell sealed up.

One variety of the Mason-bee is solitary, and builds its cell of small angular stones laid in courses and cemented together with mortar. Six to ten cells are built together and then covered with a dome as protection from the weather.

Another variety is to some extent sociable. The cells are built, sometimes in thousands, in an irregular group, without any plan, each mother occupying herself only about her own cells. When, however, all the eggs are laid the colony unites to build a dome that covers the whole group.

Such are a few of the singular habits of these insects; but there are many others, with instincts equally wonderful and distinct, for which we must refer the reader to Monsieur Fabre's charming book, 'Insect Life.'

The comb of the hive-bee was, according to Darwin, evolved from the somewhat irregular cells of the *Melipona domestica* (a Mexican species intermediate in structure between the humble-bee and the hive-bee), which constructs nearly cylindrical cells for its larva.

According to Darwin, this structure was ultimately developed by the accumulation of small improvements into the comb of

the hive-bee, and, "so far as we can see, absolutely perfect in economising labour and work." This perfect structure did not, therefore, arise either *per saltum*, or by design, or by inventive faculty of the bee, but by the fortuitous accumulations of slight improvements.

The progress from the irregular to the perfect cell must have been gradual, and many steps in the process ought to be in evidence among the various honey-gathering bees, "but," says Darwin, "the intermediaries disappeared in the struggle for existence."

If they did, why does the more imperfect structure of the melipona still survive?

The fact is that, so far as we know, there is no evidence, direct or indirect, that the comb of the first hive was not precisely the same as it is now. The honeycomb as depicted 5000 years ago in Egyptian tombs is the honeycomb of the present day.

There is nothing in the character of these various instincts, habits, or structures of the different races of the Bee family to support Darwin's hypothesis, that complex instincts and perfect structures came by accumulation of beneficial variations, or to justify his expectation that a complete fossil record of

evolution would uphold his theory. On the contrary, the contrast between the habits of different races, the new instincts in many genera that are neither inherited nor transmitted, and from their nature could not have been acquired, and the difference between their methods of reproduction and the absence of gradation between the structures they build, seem in combination to prove conclusively that the evolution of the Bee family could not have been by the accumulation of beneficial variations.

CHAPTER IX.

DARWIN'S EXAMPLES OF SPECIFIC VARIATION.

DARWIN'S arguments in favour of the specific variation of species are largely based on the differences between domestic animals and the allied wild species from which he holds they came, and especially among the numerous breeds of domestic pigeons, which, he asserts, are all descended from the rock-pigeon.

"I am fully convinced," he says, "that the common opinion of naturalists is correct —namely, that all [breeds of the pigeon] are descended from the rock-pigeon."[1] And again, "We have conclusive evidence that the breeds of the pigeon are descended from a single wild species."[2]

Breeds of domestic pigeons differ not only externally in beak, wattles, colour, arrangement of feathers, &c., but also in skeleton, as in the number of ribs, vertebræ, &c. So great is the variation, says Darwin, that

[1] Origin of Species, Ed. vi., p. 17. [2] Ibid., p. 392.

several breeds would, if found wild, be classed as distinct species and even genera.

If it could be established on satisfactory evidence that all the different breeds of pigeons are descended from the rock-pigeon, these specific variations in the skeleton of the Pigeon family would be a strong argument in favour of Darwin's theory, and we therefore seek with interest the evidence on which the statement of common ancestry is based. The result is disappointing, for we have been unable to find in any of Darwin's writings, or indeed elsewhere, any evidence, properly so called, of the common ancestry of the Pigeon family, or even that the rock-pigeon has ever been domesticated, or that a new variety of pigeon, whose stock was persistent, has ever been produced.

The nearest approach to evidence that the rock-pigeon is the common ancestor, is the experience of Darwin himself in crossing distinct breeds of domestic pigeons. "I crossed," he says, "some white fantails, which bred very true, with some black barbs, — and it so happens that blue varieties of barbs are so rare that I never heard of an instance in England,—and the mongrels were black, brown, and mottled. I also crossed a barb with a spot, which is

a white barb with a red tail and a red spot on the forehead, and which notoriously breeds very true: the mongrels were dusky and mottled. I then crossed one of the mongrel barb-fantails with a mongrel barb-spot, and they produced a bird of as beautiful a blue colour, with the white loins, double black wing-bar between, and barred and white-edged between tail feathers, as any wild rock-pigeon. We can understand these facts on a well-known principle of reversion to ancestral characters, if all the domestic breeds are descended from the rock-pigeon."[1]

Here a curious anomaly strikes us. If birds that bred very true came from the rock-pigeon, it is singular that uniformity or fixity of type should come through variation.

That the barb-spots of Darwin's experiment bred very true to their various peculiar markings indicates that this hereditary reproduction must be wrought out by some potent if delicate organisation, and it is at least mysterious how a delicate organisation so stable could be the outcome of long-continued variation. If Darwin had told us whether other characteristics of the breeds were reproduced in these hybrids, we should

[1] Origin of Species, Ed. vi., p. 18.

have seen how far the so-called reversion extended.

But accepting Darwin's theory of reversion, we do not see how it explains the circumstances. There is no appearance of reversion to a wild ancestor among mongrel puppies.

The colour of hair, wool, or feathers—semi-vitalised structures—is in many races notoriously unstable. We sometimes see white tufts on a human head of hair of a different colour. As early as the time of Jacob it was believed that the colour of hair was not necessarily hereditary, but might be changed through the eyesight; and at the present day breeders carefully protect their breeding females from seeing conspicuous colours different from their own. A mere change in the colour of hair or feathers can therefore hardly give much support to a great theory.

Accepting, however, Darwin's experience, may not the result of his experiments be otherwise explained?

We know that the mixing of two colours of paint may produce another colour different from either. May not something analogous take place when birds of different colours are crossed? and if it is assumed that the rock-pigeon was the antecessor (not the

ancestor) of all domestic breeds of pigeons, the change in colour arising from crossing two breeds may become intelligible.

The Specific life-force of almost any two breeds of pigeons must be very similar, and to produce a change in colour from that of an antecessor, would involve merely a slight modification of that portion of the organisation that determines the colour of the feathers. If now, in crossing birds of different colours, these colour forces blend, the result, as in the mixing of two paints, may be a colour different from either of the parents; or if the forces do not blend, may they not neutralise each other, and allow the colour of the remote antecessor to assert itself?

In discussing the question whether domestic breeds of pigeons are descended from one or from several wild species, Darwin says he has been greatly struck by the fact, that every breeder of cattle is firmly convinced that the breed he has cultivated is descended from a distinct aboriginal species, and the explanation of this delusion he thinks simple. "From long-continued study," he says, "they are strongly impressed with the difference between the several races, and they well know that each race varies slightly, and

they win their prizes, over selecting slight differences, yet they ignore all general arguments and refuse to sum up in their minds slight differences accumulated during many successive generations."[1]

To us the breeder's conclusion is justified by his experience, that the more he endeavours to develop the animals he breeds, the more closely do the progeny conform to the family type, and the less do the differences in expression become.

The breeder's explanation, of what he would probably consider the delusion of the theorist, might be, that long-continued efforts to explain phenomena in accordance with a favourite theory, blinds him to the significance of facts that contradict his hypothesis.

Dogs and other Domestic Animals.

Observations similar to the preceding are applicable to Darwin's examples of variation in dogs and other animals, and need not be repeated.

It may, however, be observed that, as in cattle and in pigeons, no new race of dogs has been recorded, although crosses are sometimes passed off as a new breed.

[1] Origin of Species, Ed. vi., p. 21.

CHAPTER X.

USE OR DISUSE OF PARTS AND ADAPTATIONS OF ORGANS.

According to Darwin, the use and disuse of parts, and the habits due thereto, with their consequences, are transmitted by parents to their offspring, and thus what were at first slight differences accumulated from generation to generation until they ultimately become specific variations; and conversely, by disuse organs once perfect degenerate, and come to be represented in some cases only by fragmentary remains.

It is not questioned that differences in expression of type, limited in extent, do arise from various causes. Every organ has its allotted share of the life-force of an animal, and with normal use develops normally. Experience teaches that an organ may be developed abnormally by excessive use—apparently by transfer to it of part of the life-force of some other part of the or-

ganism; for while the organ thus reinforced develops abnormal size, strength, keenness, or sensibility, as the case may be, the organs despoiled fail to attain normal development.

The energy of every life-force is limited, and if one organ benefits by appropriating a portion of the energy properly belonging to another, the advantage is not a clear gain to the animal, but merely a transference of energy from one organ to another. Athletes sometimes break down under excessive training: they have by excessive use exhausted their strength or the elasticity of the muscles excessively used.

When only certain parts of the body are developed by excessive use, other parts are abnormally weak. The senses of touch and hearing become highly developed in the blind, by transference of vital energy from the disused organs to those called into excessive use. If a cow yields milk largely, she will not put on flesh, and hence, as a rule, good milch cows are thin. On the other hand, the arm of the Indian fakir becomes withered by persistent disuse.

But all such modifications are differences only in degree, and do not disclose any tendency towards the specific variation that constitutes a new species. Moreover, the

means adopted to bring about these differences are only applicable to man, or to animals under his control.

No specific modification arises in the organs of wild animals, when brought under what seem to be more favourable conditions of existence, and such trifling modifications in expression of type as do arise, come within a limited space of time. When an animal is first exposed to an adverse climate, its protection from the weather will develop; but the development will probably be as much in the first season as it ever will be: it is not indefinite, and there is no tendency to specific variation.

Darwin attempts to prove the existence of a general law of Nature, that use and disuse of parts are attended by modifications that lead to specific variation; but although use and disuse do produce slight differences in man, and in animals under his influence, the cases among wild animals where use has not caused development, nor disuse degeneration, are sufficiently numerous to prove that there is no general law of Nature such as he seeks to establish.

Certain fishes found in caves are blind, and in some cases have only fragments of eyes; but then reptiles, and even rats, living

in the same caves, have fully developed eyes that can see after becoming accustomed to light.

According to Darwin, the inability of the domestic duck to fly is the result of disuse through domestication ; but then the logger-headed wild duck of South America does not fly. It can only flap its wings along the surface of the water.

A large proportion of the beetles in Madeira have no wings, and Darwin argues that the reason is because beetles of indolent habits or with imperfect wings flew least, and therefore were not so often carried to sea as those of more active habits : thus partly by disuse and partly by selection many genera of beetles in Madeira became wingless.

"But," Darwin continues, "the wings of beetles that must use them to live are not reduced but even enlarged, and this is compatible with natural selection."[1]

Those beetles that continued to battle with the wind had, it would appear, their wings enlarged, and survived, although this seems at variance with the preceding argument, and with the practice of the sailor, who takes in a reef when the wind becomes too strong for the safety of his craft.

[1] Origin of Species, Ed. vi., p. 109.

Upland geese, that do not frequent water, have webbed feet although they never swim. The water-hen lives habitually in water, but has not developed webbed feet like the duck, neither has the water-ousel, although it gets its food by diving. The ostrich frequently uses its wings, but has not developed the faculty of flight, and Darwin explains the failure in these words: "A moment's reflection will show what an enormous supply of food would be necessary to give this huge bird of the desert force to move its huge body through the air"; that is to say, in this case use did not develop—cause failed of its normal effect—because of the consequence. But this is an argument in favour of design and against Darwin's theory.

These examples of use and disuse to bring about modifications of structure conclusively prove that there is no general law that use or disuse of parts develops specific variation.

Acquired Habits.

Darwin does not give any examples of animals acquiring habits.

He assumes that certain habits have been

acquired; but some animals do not acquire even simple habits, although they would apparently prove of great advantage. Sir Herbert Maxwell tells us of ducks that feed only on the surface of the water. They have not acquired the habit of diving to reach their food, although they may be seen feeding on the floating *débris* brought to the surface by closely allied breeds that seek their food under water.

CHAPTER XI.

EXTERNAL INFLUENCES.

The three principal factors in producing an organism — life-force, matter, and environment—vary in their respective potencies in different races, and among individuals of the same race under different conditions.

The prepotency of Specific life-force—the force that moulds the type—is greater the more complex the organisation, while, as we descend in specialisation, the influence of one or of both the other factors becomes more evident; that is, lower organisms are more affected by external conditions, food, climate, &c., and display greater differences in expression of type, than those more highly specialised.

The differences in the respective potencies are readily observable in plants; their size, flowers, and fruit may be greatly varied by more or less favourable conditions of growth. If heat is inadequate, the plant (if it live)

will be stunted; if kept in the dark, its colour will be affected; and insufficiency of moisture will be evident in the foliage. A plant grown in a valley may change greatly in appearance on a mountain; and some trees when transported to a colder climate, although they live, may fail to blossom or to mature seed.

Man can, however, do comparatively little to alter the form, size, or appearance of seed —the part of the plant that may be taken to represent the life-force. When the fruit that envelops some seed is greatly developed by high cultivation, both the quantity and fertility of the seed are usually greatly diminished, but the appearance of the seed itself is only slightly modified, if at all. On the other hand, the vitality of seed, matured under even highly unfavourable conditions, does not seem to be seriously impaired, for the young plants from such seed readily respond to generous treatment, and may at maturity approach the normal size. It is also remarkable that reproduction is stimulated by unfavourable conditions of life: trees growing under adverse conditions yield the largest quantity of seed, and animals in like circumstances are most fertile. Statistics show that the population of Ire-

land never increased so rapidly as at the time of the great famine, and similar experience attends the periodical famines in India. By the same natural law the birth-rate in London is much higher in the poorest parishes than in the wealthiest.

The last efforts of life seem to be devoted to the perpetuation of the race rather than to the preservation of the individual life. From this we may infer Nature's reluctance to lose a type.

These phenomena, whether they arise from external or internal conditions, give no indication of a tendency towards specific variation.

Environment.

Darwin calls attention to the correlation between the colour of animals and that of the country they inhabit, and to the changes in the colour of some animals during certain seasons. This correlation he attributes to natural selection and the struggle for existence.

There is, undoubtedly, frequently a correspondence between the colour of animals and that of their habitat, and some insects exactly resemble the leaves or twigs of the

trees where they are to be found. But the exceptions to this correlation are numerous enough to show that correlation is not due to environment.

The blackcock differs much in colour from his grey mate; the mountain-hare, bluish grey in summer, becomes white in winter, but the fox, living on the same mountain, retains his colour unchanged. Grouse and ptarmigan live in almost the same localities, and in summer are similar in colour; but as winter approaches the grouse becomes a darker brown, the ptarmigan white, and the change begins long before the advent of snow.

Some butterflies are attractively and brilliantly coloured, whilst others in the same locality can hardly be distinguished from the leaves and twigs on which they rest.

Most animals in the arctic regions are white, but the sable and the musk-sheep are conspicuously brown, and other animals are of different hues.

Mr Alexander Wallace, in explanation of these inconsistencies, says: "Whenever we find arctic animals which, from whatever cause, do not require protection by their white colour, then neither the snow nor the glare have any effect upon their colouration."

But this explanation seems really an argu-

ment in favour of design; for either the cold and snow-glare fail in their normal effect in the case of animals that do not require the protection of white colour, or the fur of such animals was in some way modified so as not to be susceptible to the influence that cold and snow-glare are alleged to have.

It may be presumed that the colour of animals was adjusted to maintain the balance of life among different races. The colour of some animals aids them to capture their food, and of others to escape from becoming food. Again, in some cases colour may be a danger-signal to possible victims, and in others may add to the perils of its possessor, who, it may be assumed, has a compensating advantage in some other direction.

How can common-sense accept this marvellously delicate and intricate adjustment of the balance of life, partly by colouring and partly by faculties, as the self-evolved outcome of conflicting forces, or of what is called Chance?

The Shetland Pony.

The diminutive size of the Shetland pony has been attributed to adverse conditions of

existence for many generations, but recent experience in breeding the pony in England negatives this assumption.

A stud of Shetland ponies was established in 1882 at Holinside Old Hall Farm, near Chester-le-Street, and its manager, writing in 1898, reports that the "tendency [in height] is downwards, in fact of recent years decidedly downwards," and the herd-book of the breed confirms this statement.

The experience in breeding the pony under changed and more favourable conditions throws some light on the limits of development, and approximately on the amount of oscillation round the average type.

Before the pony attracted attention by its diminutive size, the Shetland farmers bred with an eye to increase the height, to make the animal more serviceable as a beast of burden; but when the pony came to be used in the Durham collieries, the breeders sought to diminish the height and selected the smallest sires. By this selective breeding the average height of the pony, as the herd-book shows, has been reduced about three inches — say seven per cent. The decrease in height must be due solely to selection, for better food and greater comfort in their southern quarters than in their

Shetland homes should have tended to increase their size.

There is no history or tradition of the origin of the Shetland pony. So far as known, it has always been an inhabitant of the Shetland Islands, and its characteristics have never changed. The ponies are remarkable for good temper, freedom from vice, and docility even when not handled for years, and their intelligence contrasts very favourably with that of Iceland ponies, and indeed with that of any other breed of horses. Their mature crop of hair does not come until they are three or four years old, their previous coat being more like wool than hair. These characteristics both in physique and character, coupled with the breeding experience, justify, in the absence of evidence to the contrary, the conclusion that the Shetland pony is a distinct race, and that its small size was not brought about by unfavourable external conditions of life.

Physiological.

The genesis of an organism clearly indicates that external influences cannot produce specific variation.

The embryo is the product of special forces

in the germ-cell, and the embryo develops into a fœtus that in due time evolves an adult of the type that produced the germ-cell. This outcome, except for accident, is invariable, and we conclude that before there can be any specific variation in a type there must be some change within the germ-cell of that type. But how can external influences affect the germ-plasm? A seed may, as we have seen, be stunted by climatic or other unfavourable influences; but if it do grow, it invariably produces an organism of its parental type.

CHAPTER XII.

INSTINCT AND HABIT.

DARWIN deals with the development of instinct on the same lines as the evolution of life. He assumes the existence of instinct in a simple form, and holds that complex instincts are the results of the accumulation of numerous successive slight modifications of simpler instincts. He, however, admits that certain instincts of bees and ants could not have been acquired. These have come by "spontaneous variation": others are the result of acquired habits inherited through many generations; these he calls "domestic habits." But beyond general statements Darwin gives no example of the appearance of a new instinct, or of an acquired habit becoming hereditary.

There is no evidence of any variation in the nature of an instinct, although, like other characteristics, it varies in degree in different members of the same race, and may to some

extent be cultivated or developed by man's influence. As Monsieur Fabre proved by numerous careful experiments, the operations of instinct are purely automatic,—successive repetitions of the same series of actions,—and when their sequence is altered, the animal is as devoid of intelligence to attain its object as a "penny-in-the-slot" machine in like case.

There is a certain selective faculty in instinct, just as there is in the involuntary processes of digestion and assimilation, which indeed are of the same nature as instinct. A bird may construct its nest of different kinds of mud or fibre, and the bee may make its comb from wax provided for it, but the nest and the comb are fashioned the same, as far as the difference in the materials will permit.

Instinct in Dogs.

Darwin explains the faculty of pointing in sporting dogs as follows: "When the first tendency to point was once displayed, methodical selection and the inherent effects of compulsory training in each successive generation would soon complete the work." [1]

[1] Origin of Species, Ed. vi., p. 210.

Again (p. 211): "Hence we may conclude that under domestication instincts have been acquired and natural instincts have been lost, partly by habit and partly by man selecting and accumulating during successive generations peculiar mental habits and actions, which at first appeared from what we must, in our ignorance, call an accident."

Let us examine in detail the scenting faculty of sporting and other dogs, and consider whether they are explicable on Darwin's hypothesis, which, it may be observed, assumes a tendency to point at game, or the appearance by "accident" of some peculiar habit.

The Pointer and the Setter differ from each other in physique, but both seek for, and when they come within a short distance point the muzzle in the direction of, game. The body suddenly becomes rigid—semi-cataleptic—and remains so until the game is flushed or found absent—recently flown. Neither gives tongue on approaching game; but when game is scented, the tail begins to wag vigorously, and, when within pointing distance, it and the rest of the body become suddenly rigid—the neck possibly in a rigid curve if the bird has suddenly moved to one side.

But there is a difference between the Pointer and the Setter when on point—the Pointer stands erect, and the Setter crouches cat-like. The Setter is harder to train than the Pointer, and more apt to forget: he wants some training every season. But he is the more graceful dog, and this probably accounts for his continuing to be used. Both are somewhat distant in their relations with man.

The Spaniel seeks and flushes his game without giving tongue, but does not point, and cannot be trained to do so; his only teaching is to keep within range. As compared with the Pointer or the Setter, his nose is carried closer to the ground than either, his tail never ceases its movements, and he is also more familiar with man.

The Retriever hunts game like the Spaniel, but carries his head high, seeking the scent in the air until he locates the game or its track, and then it is lowered to the ground like the Spaniel. He fetches naturally without teaching, and carries the game lightly without worrying it.

It is doubtful whether any of these sporting dogs have any special fondness for the flesh of the birds they hunt.

Foxhounds differ from sporting dogs in

giving tongue on a hot scent,—or in view,—and when they catch the fox they eat him.

The Greyhound is remarkable for speed and keenness of sight, and is of little use except for hunting hares.

The Collie is very intelligent and susceptible of education, and principally affects sheep. His nose is also good, and many hunt on their own account, eating the hares they catch.

The Lurcher is a first cross between the Greyhound and the Collie, and combines in high degree the special faculties of both races—the speed and sight of the Greyhound and the intelligence and nose of the Collie. But, like other crosses, the first is the best, and no one thinks of breeding Lurchers from Lurchers.

The Otter-hound affects otters only, and is good for nothing except hunting them. In type he is specially adapted for his work, having short legs and great bodily strength.

We might greatly extend the list, but these examples are sufficient to show—

That the physique of each breed is well adapted for its special method of hunting, and for giving advantage over the animals pursued.

That the method of hunting and capturing,

or of aiding man in capturing, is peculiar to each breed, except that the Pointer and Setter hunt alike.

That although the methods of the Pointer and Setter are the same, they differ in physique.

Now, according to Darwin's idea, the hunter who domesticated the Pointer taught him also his special method of seeking game, and also to get himself into a semi-cataleptic state when close to it.

The Retriever was taught to seek and fetch game, the Greyhound to look for, pursue, and capture hares, and the Otter-hound to hunt otters only. Each hunter must have either had sufficient insight to discern the method of hunting for which his dog was best adapted, or the physique of the dog became adapted to his method of hunting.

But the Pointer and the Setter differ in physique, although their methods in hunting are the same.

If uncivilised man was able to accomplish such feats, why is it found impracticable to teach any sporting dog of pure breed to adopt a different method of hunting, or a non-sporting dog to hunt in a particular fashion?

There is no record of the domestication of

the dog among civilised nations, and no report that savages or semi-savages have ever domesticated the allied wild species around them.

Sir Harry Johnston, in his 'Uganda,' expresses his surprise that the most intelligent negro tribes seem never to have thought of domesticating any wild animals until the advent of Europeans.

The Australian aborigines, instead of trying to domesticate the dingo—their wild dog—eat him.

There is undoubtedly all over the world a general similarity in physique between domestic dogs and their wild allies in the same locality, and this at first sight seems to support the hypothesis that domestic dogs are descended from allied wild species; but according to our theory, the wild dog was not the ancestor but the antecessor of the domestic dog, and the last step in his evolution was more a modification in character, disposition, and habits than in physical type. These differences in character are so great, and in some respects so antagonistic, that they separate the domestic dog from allied wild species as certainly as specific variations in physical type.

CHAPTER XIII.

DOMESTIC ANIMALS.

It is assumed by Darwin and other naturalists that all domestic animals come from the allied wild species; but although their similarity in appearance points at first sight to this conclusion, differences between them in temperament and disposition, as persistent as differences in physique, prove them to be distinct races.

The origin of the domesticity of all domestic animals is shrouded in mystery. We learn from the most ancient records of the human race, as well as from bones found in the *débris* of the lake-dwellings of the Neolithic age, that domestic animals have been associated with man from the earliest times, and, so far as we know, domestication has always been their natural condition.[1]

[1] Neolithic man had already domesticated the dog, horse, goat, and sheep (Page and Lapworth's Geology, p. 287).

There is nothing, either in history or legendary lore, to support the assertion that any wild race has ever been domesticated, although a feat which conferred such benefits on mankind would certainly have been deemed heroic. No new race has been added to our domestic animals in historical times.

Was domestication only possible in the days when the world was young and man an uncivilised savage?

But then Sir Harry Johnston tells us that the natives of Central Africa never thought of domesticating wild animals.

Many species of animals have been more or less tamed, but there is no authentic record of the domestication of the wild cat, ass, or boar among quadrupeds; or of the common fowl, turkey, or duck among birds; and it adds to the mystery that it is very doubtful whether the horse, the dog, or the camel is to be found in a wild state, except where it is known that they, or their predecessors, have come from domestic animals.[1]

The difference between wild and domestic animals of allied breeds lies more in their disposition and character than in their

[1] Homer's "horse-tamers" would now be called "horse-breakers."

physique. An ordinary observer would fail to distinguish any specific difference between the wild cattle in Chillingham Park and the domestic shorthorn, with which they are fertile; but although these cattle have for hundreds of years been kept in this park, and habituated to man, they are no nearer domestication than they were a hundred years ago. "One remarkable feature must not go unnoticed," says Lord Tankerville in reporting the results of breeding the Chillingham cattle with domestic shorthorns, "and that is, however possible it may be to alter the general appearance and weight of the animal, little or no influence has yet been produced in its temperament—that is, by crossing with shorthorns."

This experience indicates that characteristics of temperament are more persistent than those of physique.

The domestic reindeer of Lapland differs from the wild, and although there are wild reindeer in North America, none are domestic.

Writing on the domestication of wild animals, Mr David Wilson, judge in Moulmein, says: "There are wild cattle in Burmah—*saing* so called—whose skulls I have compared with skulls of the domestic breed.

The skulls of the wild kinds are stronger and thicker in the frontal ridge between the horns, and there is a slight difference in shape. Experienced hunters tell me that the wild cattle are uniform in colour and shape of horns, and the bull bigger than the domestic (Burman or Indian) bull. The domestic cattle of Burmah differ from the Indian domestic cattle, and are more like the native wild cattle, but, except their general similarity, there is no reason to suppose that they are the same animals domesticated. Jungle-fowl are not unlike the ordinary domestic fowl here, except that the cock is much bigger; the hens are much the same. My wife has often bought two dozen chickens in a lot, and afterwards found that half a dozen jungle-fowls had been passed off amongst them unobserved. Mr Murray, Deputy Conservator of Forests, assures me he tried in vain to domesticate them and failed, although he collected their eggs and hatched them at home.

"The wild cattle, or *saing*, are, I read in books, slightly domesticated by some hill tribes (Chins). The tamed *saing* are said to live in the forests in a condition very similar to their wild state. But the case of the elephant seems the strongest argument

against the possibility of domestication. Alexander the Great found in India tamed elephants that were used in battle, and yet to this day they very rarely breed in domestication. I know they are still caught wild in India and then tamed. In Burmah some hill folks half domesticate them. They are kept tamed under wild conditions—that is, given little work and allowed to gather their own food in the forests: under these circumstances the elephant does breed."

Both among civilised and uncivilised people females of domestic breeds are sometimes mated with wild males of the allied races, for the purpose not so much of improving the physique as of increasing courage or ferocity of disposition.

In connection with domestication, the evolution of the Horse is extremely interesting. Palæontologists tell us that the Horse as we see him is the outcome of evolution through several epochs, and that as we know him he first appeared in the Pleistocene age, probably about the same time as man. In that age the formerly marshy surface of the earth had become hard and the herbage denser, and the changes in structure in his last transformation were principally in the feet and jaws,

adapting him more closely to the new conditions in which he was to live. The three toes he possessed in the preceding age were consolidated into one—the hoof; the teeth became at the same time better adapted for grinding hard food, and a new substance—cement—appeared on the crown of the tooth. Further, the diastema (the toothless gap in the jaw) lengthened. The changes in the feet and teeth were advantageous to the animal itself, and at the same time rendered him more serviceable for the use of man; but the benefit of the diastema to the Horse himself is not apparent. Its advantage to man is, however, great; for if the diastema did not provide a recess for the bit of the bridle, it would be extremely difficult to control him.[1]

Now these modifications, from their nature, could not have arisen either from the accumulation of slight beneficial variations or from use or disuse, and it is significant that these modifications, necessary for the existence of the Horse in his new conditions of life, occurred at the same time in organs so distinct from each other as the jaws and the feet. Whatever the

[1] Hence the metaphor describing the action of a headstrong man, "He has got the bit between his teeth."

cause, it is remarkable that the new modifications unquestionably adapted the Horse more fully for the service of man, and that both first appeared in the same geological period.

The mystery of domestication is not confined to animals. Neither wheat, barley, oats, nor rice is found anywhere growing wild, and neither seed that will produce the cultivated sugar-cane nor seed of the cultivated banana has yet been discovered.

Sir Harry Johnston, evidently a believer in Darwin, feels himself unable to explain, by his theory, the peculiar characteristics of the banana, a fruit on which the natives of Uganda largely subsist.

In his extremely interesting work on Uganda the question is discussed at some length, and we cannot do better than quote his remarks.

"The cultivated banana," he says, "is possibly not native to Africa in its origin. I believe botanists consider that it first diverged from wild forms of Musa in Eastern Asia, and, like all the other food products cultivated by the negro, travelled to tropical Africa from India at some prehistoric period. I too held this opinion once, but I cannot endorse it so heartily now on reflection.

"I believe there is no record of the banana having been known to the ancient Egyptians. Its scientific name, 'Musa,' is of course only a latinising of the Egyptian Arabic word *mus*, and Muhammadan Egypt only knew the fruit in the middle ages.

"Therefore it is not very likely that the cultivated banana reached tropical Africa from Asia by way of Egypt, since its introduction to Negroland would be at most too recent to explain its long connection with negro life as testified by linguistic evidence; neither is it easy under present climatic conditions to conceive of the plant having been cultivated from Western India through Southern Persia and right across it into Arabia.

"Was it by any possibility brought by some navigating people like the Phœnicians or Sabeans across the Indian Ocean, and started as an introduced plant on the east coast of Africa, thence to spread right across the continent to the Atlantic Ocean?

"Could it be possible that the emigrants of Malay races speaking languages allied to the Polynesian stock, who at unknown and distant periods drifted across the Indian Ocean from Sumatra and Java to Madagascar, brought with them clumps of banana-

roots? This does seem extremely improbable.

"The cultivated banana produces, it must be remembered, no seed, and therefore can only be propagated by dividing the roots. Each year the banana, which in the botanical system is not far off the Orchid group, sends up, like an orchid, a fresh stem from a new root, while the old one, after flowering and fruiting, dies. Did the Arabs introduce the cultivated banana from Eastern Asia into Eastern Africa as they did into Egypt?

"If so, they could only have done this—even if they did it before the Islamic period—as far back as about 2000 years ago.

"If this was the means of its introduction into tropical Africa, then in that relatively short period it has spread over all the tropical regions of the continent as a cultivated plant.

"Of course I am fully aware that several wild species of Musa are indigenous to Africa, as others are to Madagascar. Is it quite impossible that none of the indigenous species of Musa could have originated the cultivated form of the African banana? The fruit of all these wild species differ from the cultivated fruit very markedly

in developing large black seeds, which are embedded in a pulp that not even an anthropoid ape could eat with any pleasure.

"Is it possible that the slightly bitter, dry, tasteless, white pith surrounding these large inedible seeds could have been any attraction to primitive man in Africa, so that he protected and fostered one of these species of Musa until it developed into the cultivated banana, exactly like the cultivated banana separately developed in Eastern Asia?

"It would be difficult in any case to make a Nuganda of to-day believe that his beloved food substance which provides him with a mass of nourishing vegetable pulp, with a dessert fruit, with sweet beer and heady spirit, with soap, plates, dishes, napkins, and materials for foot-bridges, was not always indigenous to the land he dwells in, and of which it has become the distinguishing feature."

CHAPTER XIV.

NATURAL SELECTION OF SPECIES.

The outcome of the struggle for existence is, as we have seen, the elimination of the less fit; but the selection of races is determined more by conditions of existence than by direct conflict between competing species—more by quality of soil and climate than by a direct struggle between individuals of different races.

We believe that by natural law every locality tends to produce the most highly organised race of animal or plant that its soil, climate, and other conditions can adequately support. In other words, Nature automatically selects the race that makes the greatest demands on resources she can supply, and thus determines the predominance of a particular species of animal or plant in a locality.

In civilised countries the distribution of the larger mammalia is due to man's inter-

vention, and therefore examples of Nature's method of selecting races are few; but we know that the size and quality of domestic animals depend on the quality of their food and conditions of life. Graziers, for example, can tell by the appearance of cattle or sheep the character of the pasture on which they have been reared. The superior quality of Lochleven trout, so well known to the angler and the epicure, is due to the character of the bed of the lake. Its fertile mud is covered with highly nutritious aquatic plants, on which molluscs and other forms of life find abundance of food; these, again, provide generous nutrition for fishes, and they respond both in number and quality. Trout in streams or lakes on mountains composed principally of granitic rocks also exemplify the law, but in the opposite direction. Neither the soil nor the water in such localities contains much nutrition for plants or the lower forms of life; food is in consequence scanty and innutritious, and the trout small in size and poor in quality.

It is, however, in the vegetable world that Nature's law of selection can be most easily studied. Among the Rothamstead agricultural experiments one of the most interest-

ing and instructive is a series of plots showing the effects of different manures on pastures of mixed grasses.

The plots were differently manured for many years, the same manure being continuously applied to each, but they were neither cultivated nor artificially seeded, yet in the course of years the proportions of the various grasses in the several plots have greatly changed. Where manure, chiefly of a stimulating character, had been applied, the coarse, rank, innutritious grasses have largely increased; and where another kind enriched the soil principally with mineral food, the fine, highly nutritive grasses have prevailed and ousted the coarser and ranker varieties, although the latter are in appearance more robust.

Success in farming is largely based on this principle of natural selection, and its operation is very noticeable in bringing an exhausted farm, overrun by weeds, into a high condition of fertility.

So long as the farm remains poor in condition the weeds cannot be eradicated, because the land does not contain subsistence for anything better. But when the resources of the soil are sufficiently reinforced to produce a good crop of cereals,

the weeds, without being directly attacked, disappear, not because there are no seeds in the soil—seeds there are in abundance—but because its fertility can now meet the demands of more highly organised plants, and the conditions are in consequence unfavourable to lower forms of vegetation.

The gardener knows that every plant prefers a certain quality and texture of soil, and that it is as impracticable to grow some in rich soil as others in poor.

In virgin countries beautiful grassy glades may sometimes be seen in a primeval forest, or groups of trees adorning grassy slopes, as in an English park.

In one locality the soil could provide the sustenance necessary for the more highly organised grass, and it prevailed against forest trees: where the resources were inadequate for grass Nature selected trees.

When an old forest dies, the trees that naturally replace it are usually of a different species from their predecessors, and sometimes new in the locality. The climatic conditions may have remained unchanged, but the timber of the old forest had appropriated so much of some of the mineral

constituents of plant food that a sufficient supply was not left to retain the ascendancy for the same kind of tree, and Nature automatically selected another variety that required less of the elements exhausted by the former crop, and whose seeds were no doubt lying dormant in the soil.

It thus appears that Nature's method of evolution is, when available resources become more abundant, not to develop an existing animal or plant into a new species, but to supplant it by another more highly organised.

CHAPTER XV.

GENERAL SUMMARY.

The admitted facts of evolution are :—

Life first appeared on the earth in simple forms, and its evolution, as a rule, developed upwards—that is, new types as they successively appeared were more and more fully specialised.

But to this general rule there are exceptions, in which a succeeding type was, to a more or less important extent, less highly specialised than its antecessor—that is, retrogressive.

Evolution proceeded in a main line that ultimately culminated in man, but in its progress many branches sprang from the main stem, and developed until their specialisation also culminated.

Successive types are in structure and organisation more or less similar to each other.

Assuming the existence of life in its

simplest forms, Darwinism professes to explain the process of evolution and the preceding facts by the theory—

That new species were evolved from their predecessors by secondary causes, of which natural selection was the principal;

That natural selection—the outcome of the struggle for existence—selected for survival animals that had, as compared with their fellows, some beneficial difference;

That beneficial differences did appear, and when accumulated by heredity became specific variations, and gave rise to new species; and

That this process was aided by the use, disuse, or adaptation of organs, and by changes in the conditions of existence.

Darwin's principal arguments in support of these conclusions are based on—

The similarity in structure and organisation between successive types in the same line of evolution.

The differences among domestic animals of the same race.

The (alleged) beneficial differences that arise in greater or less degree among all animals.

The (assumed) indefinite accumulation of beneficial differences.

The modifications that arise from changed conditions of life and from use, disuse, or adaptation of organs.

But in the preceding chapters we have submitted facts and arguments to prove—

That the inference from the similarity of successive types, that a new race was evolved from its predecessor by secondary causes, is negatived by the geological record and by the facts of retrogression.

That the differences between animals of the same species do not indicate any tendency to specific variation, but are merely variations in expression of type arising from differences in conditions of life or selective breeding.

That development of type under selective breeding is limited by sterility or precocity.

That the accumulation of beneficial differences (development) does not go on indefinitely, but may attain its maximum in three generations.

That no new type has been evolved by selective or by cross breeding, and that, so far as known, no new persistent type has ever appeared.

That the struggle for existence does not tend to produce beneficial differences, and that its function is to maintain, by eliminating the least fit, an average type.

That natural selection not only fails to account for the phenomena of evolution, but is at variance with its facts.

That external conditions, although they may modify to a limited extent expression of type, do not tend to bring about specific variation.

Finally, that the embryo of every mammal presents in its growth the same phases that appeared in the embryo of its first ancestor, and therefore that the germ-plasm of a mammal is not altered by modifications of its corpus.

If these conclusions are established, it follows—

That the Darwinian theory not only fails to account for, but is contrary to the facts of, evolution, and, according to Huxley's test of a hypothesis, "it falls to the ground—it is worth nothing."

We fully recognise that our theory, even if established, does not advance our knowledge of the causes of evolution or of the means by which it was effected; it professes

to explain only the method in which evolution progressed.

Of the mystery of evolution—of the purpose of the higher or lower specialisation of successive types, or the means by which their differentiation was effected—we know and can know nothing, any more than we can fathom the mystery of life or of its origin.

CHAPTER XVI.

CONCLUSION.

If the Darwinian theory is based on inference unsupported by substantial evidence — the conclusion at which we have arrived in the preceding chapters—it may well be asked why it was so readily accepted by men of science.

Some explanation of the anomaly may be found in the predisposition among educated men, at the time when the theory was first announced, to accept a theory such as Darwin advanced.

The then recent demonstration by geologists that the world, as we see it, had been gradually evolved in the course of ages, had convinced all unprejudiced minds that the Mosaic cosmogony, as interpreted, was not in accordance with the facts; and this triumph of science over theological dogmatism naturally predisposed the scientific world to believe that Darwin had done for

the world of life what the geologists had done for the world of matter. As geologists had demonstrated that our world had been evolved from chaos by natural forces, in the course of millions of years, so Darwin, it was thought, had shown how its present inhabitants had been evolved from simple forms by natural forces, operating through very extended periods of time. The evidence might not as yet be complete, but further research would doubtless fully establish the new hypothesis.

But this expectation has not been fulfilled. The generation that has passed away since Darwin's death has added little to his facts or arguments, and now a critical examination of the theory must lead to the conclusion that it is wholly based on inference, and is not supported by substantial evidence.

The intellectual anomaly involved in the ready acceptance of Darwin's hypothesis by men who had criticised and discredited the Mosaic narrative, is not without precedent. In times past some of the best intellects of their day were beguiled from the direct path to knowledge by vain disputations on the properties of angels, or by profitless search for the philosopher's stone, or by the hope of squaring the circle, and it is not improbable

that the efforts during the last half century to discover the means whereby evolution was effected will in their turn be regarded with feelings akin to those we experience, when we think of the talents largely wasted by the wise men of old in their quest of the unattainable.

Biologists have exhibited almost superhuman patience, acumen, and perseverance in seeking to discover the first processes of life and the genesis of organisms, but we venture to suggest that such investigations are neither the fittest to discover the general plan of life, nor the meaning of its phenomena. A landscape cannot be viewed through a microscope, nor the design of an edifice apprehended by scrutiny of the bricks of which it is composed or of the manner in which they are cemented together.

Although we had no knowledge of the origin of a cathedral, we should without hesitation conclude that an architect to design and a master-builder to direct construction were as indispensable to bring such an edifice into existence, as the materials of which it is built or the hands that carried out the master-builder's instructions. And if we should be told, that after the foundations were laid this symmetrical building that commands our

admiration was the outcome of a hundred masons working without design, instructions, or concert, common-sense would regard the statement as an insult to the understanding.

But Darwin asks us to believe that organisms, far more elaborate and complicated than any work of man's hands, are the outcome of an analogous process.

Common-sense will prefer to believe, that as the great works of man had their architect, master-builder, and artificers, so also had the infinitely more wonderful works of Nature their Architect and Master-builder, whose artificers we call the forces of Nature.

According to the Darwinian conception, Nature failed at first to produce perfect or at least highly organised animals, and their perfection or higher specialisation came by secondary causes, each working independently and fortuitously, without design control or definite object. We could as easily believe that a box full of miniature bricks persistently shaken through a geological epoch would form themselves into a miniature cathedral.

To Darwin's mind "it accords better with what we know of the laws impressed on matter by the Creator, that the production and the extinction of the past and present

inhabitants of the world should have been due to secondary causes like those determining the birth and death of the individual." [1]

Others, who believe that they also study Nature with a single eye to truth, arrive at a very different conclusion. In their opinion the phenomena of organic evolution, the homology throughout Nature, the law and order that everywhere prevail, and the adaptation of organisms to the conditions under which they were to live, all but conclusively demonstrate that the diversified forms of life that successively appeared on our globe, instead of being the fortuitous outcome of secondary causes, were successively called into existence on a preconceived plan, and continue to be reproduced and sustained by Infinite Intelligence and Almighty Power.

[1] Origin of Species, Ed. vi., p. 428.

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